

## **General Disclaimer**

### **One or more of the Following Statements may affect this Document**

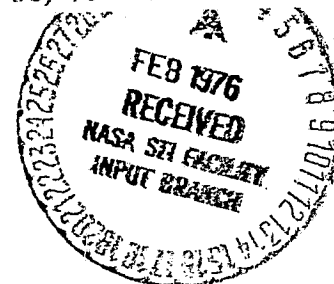
- This document has been reproduced from the best copy furnished by the organizational source. It is being released in the interest of making available as much information as possible.
- This document may contain data, which exceeds the sheet parameters. It was furnished in this condition by the organizational source and is the best copy available.
- This document may contain tone-on-tone or color graphs, charts and/or pictures, which have been reproduced in black and white.
- This document is paginated as submitted by the original source.
- Portions of this document are not fully legible due to the historical nature of some of the material. However, it is the best reproduction available from the original submission.

(NASA-CF-148726) STS USERS STUDY (STUDY  
2.2). VOLUME 3: ANCILLARY EQUIPMENT STUDY  
Final Report (Aerospace Corp., El Segundo,  
Calif.) 160 p HC \$6.75 CSCL 22B

N76-30259

Unclas  
15207

G3/16



# STS Users Study (Study 2.2) Final Report

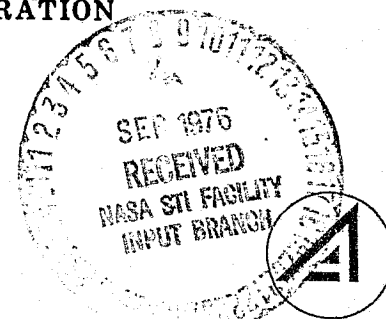
## Volume III: Ancillary Equipment Study

Prepared by ADVANCED MISSION ANALYSIS DIRECTORATE  
Advanced Orbital Systems Division

1 November 1975

Prepared for  
OFFICE OF SPACE FLIGHT  
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
Washington, D. C.

Contract No. NASW-2727



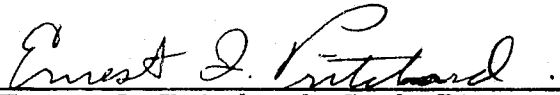
Systems Engineering Operations  
THE AEROSPACE CORPORATION

Aerospace Report No.  
ATR-75(7362)-1, Vol. III

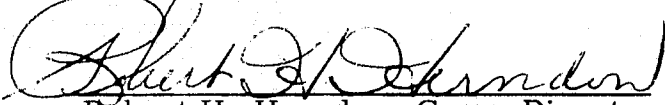
STS USERS STUDY  
(STUDY 2.2) FINAL REPORT

Volume III: Ancillary Equipment Study

Prepared by:

  
Ernest I. Pritchard, Study Director  
Study 2.2  
Advanced Mission Analysis Directorate

Approved by:

  
Robert H. Herndon, Group Director  
Advanced Mission Analysis Directorate  
Advanced Orbital Systems Division

## FOREWORD

The STS Users Study (Study 2.2) Final Report is comprised of three volumes titled as follows:

- Volume I - Executive Summary
- Volume II - STS User Plan (User Data Requirements) Study
- Volume III - Ancillary Equipment Study

PRECEDING PAGE BLANK NOT FILMED



## ACKNOWLEDGEMENTS

Mr. William F. Moore, STS Operations Office, Office of Space-flight, NASA Headquarters, managed and directed the Ancillary Equipment Study. Mr. Wilbur Thompson of NASA MSFC assisted and supported the study by furnishing Multi-Mission Support Equipment data and information. Information on NASA planned STS Ground Support Equipment was furnished by Mr. Charles Hart, NASA KSC.

The Aerospace Corporation effort on the Ancillary Equipment Study was accomplished by the following Members of the Technical Staff:

Orbiter/Payload Support

T. W. Trafton

IUS/Payload Support

R. T. Blake

F. K. Hawkins

RTG Cooling Unit

J. Vasiliu

Electrical/Avionics Support

F. J. Tobias

Fluid Support

K. A. Turner

Mission Specialist and Payload Specialist Station

O. J. Mead

Launch Site Support Equipment

R. M. Coulston

Study Direction, Selection of Equipments, and Liaison with NASA

J. A. Plough

E. I. Pritchard

## CONTENTS

1.	INTRODUCTION . . . . .	1-1
2.	SUMMARY OF RESULTS . . . . .	2-1
3.	MULTI-MISSION SUPPORT EQUIPMENT (MMSE) LISTS . . . . .	3-1
3.1	Launch Site MMSE List Selected for Study . . . . .	3-1
3.2	On-Line MMSE List Selected for Study . . . . .	3-1
4.	DOD PAYLOAD AND STS/PAYLOAD INTERFACE DATA . . . . .	4-1
4.1	DoD Payload Data Sheets . . . . .	4-2
4.2	DoD On-Line Ancillary Equipment Needs List . . . . .	4-2
5.	POTENTIAL DOD APPLICATIONS . . . . .	5-1
5.1	On-Line MMSE Lists for Application Analysis . . . . .	5-1
5.2	IUS/Payload Support . . . . .	5-12
5.2.1	Summary . . . . .	5-12
5.2.2	MMSE Data Sheets . . . . .	5-13
5.3	Orbiter Payload Support . . . . .	5-13
5.3.1	Summary . . . . .	5-13
5.3.2	MMSE Data Sheets . . . . .	5-14
5.4	RTG Cooling . . . . .	5-52
5.4.1	Introduction . . . . .	5-52
5.4.2	MMSE and Orbiter Characteristics . . . . .	5-52
5.4.3	Comments on the Selected System . . . . .	5-53
5.4.4	Comments on the Need for an RTG Coolant Jacket . . . . .	5-54
5.4.5	MMSE Data Sheet . . . . .	5-54
5.5	Electrical/Avionics Support . . . . .	5-57
5.5.1	Summary . . . . .	5-57
5.5.2	MMSE Data Sheets . . . . .	5-58

PRECEDING PAGE BLANK NOT FILMED

## CONTENTS (Cont'd)

5.6	Fluid Support .....	5-67
5.6.1	Introduction .....	5-67
5.6.2	Fluid Services MMSE .....	5-69
5.6.3	Propulsion Systems Leakage Protection .....	5-69
5.6.4	Propellant Dump .....	5-74
5.6.5	Propellant Fill and Drain .....	5-74
5.6.6	MMSE Data Sheets .....	5-74
5.7	Mission Specialist and Payload Specialist Stations .....	5-83
5.8	Launch Site MMSE .....	5-84
5.8.1	Introduction .....	5-84
5.8.2	Approach .....	5-84
5.8.3	Ground Rules and Assumptions .....	5-85
5.8.4	DoD Applicability of NASA Launch Site MMSE .....	5-86
5.8.5	Interface Verification Equipment (IVE) Level I (Orbiter) .....	5-87
5.8.6	MMSE Data Sheets .....	5-90
6.	PAYLOAD/IUS INTERFACE (MMSE) STRUCTURE STUDY .....	6-1
7.	SUMMARY OF STUDY ACCOMPLISHMENTS .....	7-1
8.	RECOMMENDATIONS FOR ADDITIONAL EFFORT .....	8-1
9.	REFERENCES .....	9-1

## TABLES

2-1.	Summary of Potential Applicability of MMSE to DoD Payloads . . . . .	2-2
2-2.	Summary of Potential Applicability of MMSE and Recommendations . . . . .	2-3
2-3.	Summary, Launch Site MMSE Applicable to DoD Payloads . . . . .	2-7
3-1.	Launch Site MMSE, GSE Ancillary Equipment to be Considered in Study, KSC Recommended MMSE Equipment List . . . . .	3-2
3-2.	On-Line MMSE to be Considered in Study, MSFC Recommended On-Line MMSE List, Automated Payloads Only . . . . .	3-3
4-1.	Summary of DoD On-Line Ancillary Equipment Needs (From DoD STS/Payload Interface Contractor Study Reports . . . . .	4-3
5-1.	Ancillary Equipment List Status Prior to Application Analysis . . . . .	5-2
5-2.	On-Line MMSE List for Application Analysis to DoD Payloads . . . . .	5-8
5-3.	Salient Features of DoD Payloads . . . . .	5-68
5-4.	Adaptability Matrix of MMSE to DoD Payloads . . . . .	5-73
6-1a.	IUS/Payload Support MMSE Utilization, 4.5 m Diameter Spacer, Payload Mounting Beam and Associated Equipment . . . . .	6-4
6-1b.	IUS/Payload Support MMSE Utilization, 176 in Diameter Spacer, Payload Mounting Beam and Associated Equipment . . . . .	6-5
6-2a.	IUS/Payload Support MMSE Utilization with Modified 3.5 m Diameter XPLS Spacers and Associated Equipment . . . . .	6-6
6-2b.	IUS/Payload Support MMSE Utilization with Modified 138 in Diameter XPLS Spacer and Associated Equipment . . . . .	6-7
6-3.	MMSE Utilization on DoD Payloads, 4.5 m (176 in) Diameter Spacer . . . . .	6-8

## FIGURES

5-1.	Payload/Orbiter Fluid/Gas Interfaces, Orbiter Deployed Payloads . . . . .	5-70
5-2.	Payload/Orbiter Fluid/Gas Interfaces, IUS Deployed Payloads . . . . .	5-71
5-3.	Payload/Orbiter Fluid/Gas Interfaces, Pallet Mounted Payload . . . . .	5-72
5-4.	Shuttle/Orbiter Payload Interface Verification Equipment (IVE) Concept . . . . .	5-91
6-1.	DSP and DSCS Payloads In Tandem Configuration, 4.3 m (170 in) Spacer . . . . .	6-9
6-2.	FSC and DSCS-II Payloads In Tandem Configuration, 4.3 m (170 in) Spacer . . . . .	6-11
6-3.	DSCS Plus DSP Payloads In Tandem Configuration, 2.67 m (105 in) Spacer . . . . .	6-13

## 1. INTRODUCTION

NASA is considering definition and development of Multi-Mission Support Equipment (MMSE). NASA needs to understand which support equipment under consideration is potentially useful for DoD STS payloads as they are currently planned. The objective of the study is to describe, from NASA's point of view, the potential for NASA/DoD common usage of ancillary equipment.

In the Ancillary Equipment Study the ancillary equipment needs for DoD payloads were examined. These equipment needs were then matched against the MMSE planned by NASA for study or definition by NASA in the coming year. Thirty-four on-line MMSE items are potentially applicable to one or more DoD payloads in the near term. Similarly, 19 of the launch site MMSE are candidates for application to DoD payloads. These 53 candidate equipments were then examined in light of the ancillary equipment needs in accordance with DoD STS/payload interface contractor studies and the data available on near-term DoD STS payloads. The end products of this effort are the descriptions of the potentially applicable MMSE items to DoD payloads, as described on the MMSE Data Sheets presented in Section 5 and summarized in Section 2.

In accomplishing this study, the MMSE was taken directly from the NASA MMSE catalogs (see References 1 and 2). Whenever possible, the MMSE was used in accordance with the description furnished in the Martin Marietta study. If modifications to the MMSE description appeared to be desirable for the purpose of enhancing the applicability to DoD payloads, the recommendation for such modification is described on the MMSE Data Sheets presented in Section 5. The orbiter/payload interface used in these studies was that presented by Rockwell International in the DoD STS Payload Interface Concept Studies (see References 3 and 4).

The initial upper stage (IUS) assumed for this study uses solid propellant rocket engines. The IUS/payload structural interface is identical to the Transtage interface. Performance and other features assumed for the IUS are those described in the STS Users' Guide, Section 10 (see Ref. 5). These latter data represent a so-called "generic" IUS.

The STS/payload interface studies used as a basis for DoD ancillary equipment needs in this study have been accomplished by DoD contractors over the past three years (see Refs. 3, 4, 6, 7, 8, 9, and 10). These studies covered six DoD satellites plus a Radio Isotope Thermo-electric Generator (RTG). Thus the ancillary equipment needs for these six satellites could be defined adequately. Six other satellite projects from the DoD Space Mission Model (FY 1980 through FY 1991), Revision 4 (see Ref. 11), were also covered by this study. The interface equipment needs for these six other satellites are similar to the needs for one or more of the six satellites studied by DoD STS payload interface study contractors.

The tasks covered in this report were accomplished in the period April through September 1975.

## 2. SUMMARY OF RESULTS

The Multi-Mission Support Equipment (MMSE) potentially applicable to the six DoD payloads studied are listed in Table 2-1. The table indicates the individual satellite projects to which each MMSE is applicable. In addition, the table indicates which equipments are applicable to multiple payload configurations when more than one project's payload would be flown on the STS. For instance, when the equipment is used only if the DSCS satellite were flown either with the DSP or FSC satellites, or could be flown with a non-DoD satellite, it is indicated in the column under multiple payload. The number of other DoD satellite projects listed in the DoD Space Mission Model to which each of the equipments is potentially applicable is listed in the column headed "other."

Table 2-2 summarizes the potential applicability of MMSE to the DoD and non-DoD payloads. The applicability to the non-DoD payloads is that determined in the Martin Marietta MMSE study (see Refs. 1 and 2, and 12 through 17). The NASA status for each of the MMSE items listed is shown in accordance with the recommendations made by MSFC to NASA Headquarters in the June MMSE review. Also shown are the date of the first flight which has a potential need for each of the equipments recommended for DoD application and an estimate of the first date on which interface definition information would be needed by a DoD payload project.

In the near term STS era, 15 on-line MMSE items were found to have one or more potential users among the DoD payload projects. Eight of the 15 MMSE items are associated with the IUS/



Table 2-1. Summary of Potential Applicability of MMSE To DoD Payloads

MMSE		POTENTIAL DOD SATELLITE APPLICATIONS, PRE-TUG ERA									
Name	Ident.	DSCS-II	DSP	FSC	GPS	DMSP	SOSS	RTG	Multiple Payload <sup>(1)</sup>	Other	Total
IUS/Payload Structure											
Payload Interface Adapters	PIA-2				X					1	2
Payload Interface Adapters	PIA-3	X	X	X						4	7
Payload Mounting Beam	XPBM-1				X						1 <sup>(3)</sup>
Payload Mounting Beam	XPBM-2	X <sup>(2)</sup>	X	X	X				X <sup>(2)</sup>	5	9 <sup>(1)</sup> (2)
Payload Mounting Beam	PMB-2	X <sup>(2)</sup>				X			X <sup>(2)</sup>	1 <sup>(2)</sup>	[2 + Mult <sup>(1)</sup> ]
Payload Spacer	XPLS-2				X					1 <sup>(4)</sup>	2 <sup>(1)</sup>
Payload Spacer	XPLS-3	X <sup>(2)</sup>							X <sup>(2)</sup>	X	1 + Mult <sup>(1)</sup>
Payload Spacer	PLS-4	X <sup>(2)</sup>							X <sup>(2)</sup>		[1 + Mult <sup>(1)</sup> ]
IUS/Tug Adapter	ITA-1	X <sup>(2)</sup>							X		[1 + Mult <sup>(1)</sup> ]
Payload Service Plates	PSP-1,2	X	X	X	X	X				5	10
Separation Latch & Pushoff	SLP-1	X	X	X	X	X				5	10
Orbiter/Payload Structure											
Automated Payload Sup't.	APS-1					X				1	1
General Purpose Platform	GPP-2					X		X		1	3
Payload Shroud	06-02		X								1
RTG Cooling Unit	06-01								X		1
STS/Payload Power and Avionics											
Orbiter/Payload Service Cable and J-Box	05-01								X <sup>(5)</sup>	X <sup>(5)</sup>	Mult <sup>(5)</sup>
Orbiter/Payload Service Cable (IUS Deployed)	05-03	X	X	X		X	X		X	5	10 + Mult <sup>(1)</sup>
Payload Umbilical Cable	05-04	X	X	X		X	X		X	5	10 + Mult <sup>(1)</sup>
Purge System	06-03					X					1

(1) Two different payloads (DSCS-II & DSP, DSCS-II & FSC) sharing IUS flight, STS operator may be the "user".  
 (2) XPLS-3 and XPMB-2 used if XPLS-3 design diameter increased as recommended (see MMSE sheet) instead of PLS-4, PMB-2 and ITA-1.

(3) Recommended looking into tandem mounting of XPMB-1 (up to 3 decks).

(4) Additional use in shared flights is possible but needs additional study.

(5) Modified to service IUS in payload bay with "add-a-cable" approach.

Table 2-2. Summary of Potential Applicability of MMSE and Recommendations

MMSE		NUMBER OF POTENTIAL SATELLITE APPLICATIONS					
Name	Identification	DoD <sup>(1)</sup>	NASA & Civil		NASA Status <sup>(2)</sup>	DoD Potential Need	
			1980, 1981	1980-1991		Flight Date	Interface Def. Date
IUS/Payload Structure							
Payload Interface Adapters	PIA-2	2	3	17	Group II	1981	Early '76 ✓
Payload Interface Adapters	PIA-3	7	3	15	Group II	1981	Early '76 ✓
Payload Mounting Beam	XPMB-1	1	4	≥4 <sup>(3)</sup>	Group II	1983	1978 ✓
Payload Mounting Beam	XPMB-2	9	1	≥1 <sup>(4)</sup>	Group II	1981	Early '76 ✓
Payload Mounting Beam	PMB-2	2 + Mult <sup>(5)</sup>	4	≥4 <sup>(6)</sup>	Group II	----	----
Payload Spacer	XPLS-2	2	2	≥2 <sup>(7)</sup>	Group II	1981	Early '76 ✓
Payload Spacer	XPLS-3	1 + Mult <sup>(5)</sup>	2	≥2 <sup>(8)</sup>	Group II	1981	Early '76 ✓
Payload Spacer	PLS-4	1 + Mult <sup>(5)</sup>	0	≥0 <sup>(9)</sup>	Group II	----	----
IUS/Tug Adapter	ITA-1	1 + Mult <sup>(5)</sup>	≥0 <sup>(10)</sup>	≥0 <sup>(10)</sup>	Group II	----	----
Payload Service Plates	PSP-1, 2	10	All	All (81)	Group II	1981	Early '76 ✓
Separation Latch & Push-Off	SLP-1	10	All	All (81)	Group II	1981	Early '76 ✓
Orbiter/Payload Structure							
Automated Payload Support	APS-1	1	4	13	Group III	----	---- (11)
General Purpose Platform	GPP-2	3	≥0 <sup>(12)</sup>	≥0 <sup>(12)</sup>	Group II	1980	1975 ✓
Payload Shroud	06-02	1	3	17	Group III	1981	1976 ✓
RTG Cooling Unit	06-01	1	1	11	Group III	1981 <sup>(13)</sup>	---- ✓
STS/Payload Power & Avionics					Group II, Group III		
Orbiter/Payload Service Cable and J-Box	05-01	Mult <sup>(14)</sup>	5	31	↓	1981	Early '76 ✓
Orbiter/Payload Servicing Cable (IUS Deployed)	05-03	10 + Mult <sup>(5)</sup>	6	54		1981	Early '76 ✓
Payload Umbilical Cabling (IUS Deployed)	05-04	10 + Mult <sup>(5)</sup>	7	55		1981	Early '76 ✓
Purge System	06-03	1	5	20		1983	1978 ✓

(Notes on page 2-4)

✓ = Recommended for consideration as potential joint venture, NASA/DOD.

ORIGINAL PAGE IS  
OF POOR QUALITY

Table 2-2. Summary of Potential Applicability of MMSE  
And Recommendations (Cont'd)

Notes:

1. Pre-Tug era.
2. Group II - Recommended for FY 78 start; Group III - Candidates for study in FY 76.
3. Small diameter multiple (side-by-side) payloads using PIA-1, -2, or equivalent payload interface diameter up to 86 inches.
4. Individual and multiple (tandem) payloads using PIA-1, -2, -3, or equivalent payload interface diameter up to 131 inches.
5. Two different payloads sharing IUS flight (DSCS-II and DSP, DSCS-II and FSC); IUS operator may be the user.
6. Individual and multiple (tandem) payloads using PIA-1, -2, -3, -4, or equivalent payload interface diameter up to 172 inches.
7. Payloads with kick stages and some multiple (tandem) payloads.
8. For tandem-mounted payloads.
9. For large diameter, tandem-mounted payloads.
10. As required for IUS flights with large diameter payloads.
11. General Purpose Platform recommended instead.
12. Potential payloads include carry-on pallet overflow and those with special viewing constraints.
13. Needed in 1981 by NASA; DoD need date not known.
14. Modified to service IUS in payload bay with add-a-cable approach.

payload structural interface (see Table 2-2). The General Purpose Platform (GPP-2) could be used to mount any one of three DoD payloads piggyback in the orbiter bay in the Spacelab tunnel. Even though the Automated Payload Support (APS-1) could be applied to at least the DMSP payload, it is not recommended for further consideration as a common NASA/DoD equipment since (1) the General Purpose Platform is expected to be a preferred method of support, and (2) excessive dynamic loads for cantilever-mounted payloads are expected. A payload shroud may be needed by at least one DoD payload (DSP) and MMSE item 06-02 is large enough to accommodate the DSP. In addition, the low earth altitude payloads SOSS and DMSP may need shrouds. If the MMSE shroud can be mounted from the payload itself, it may be applicable to the DMSP payload as well.

The RTG Cooling Unit (06-01) satisfies the DoD cooling capacity requirements and could be a common MMSE item for DoD and NASA.

The Orbiter/Payload Servicing Cable (IUS Deployed) MMSE item (05-03) is potentially useful to at least ten DoD payloads and some multiple payloads on the IUS. The Payload Umbilical Cabling (05-04) which mates with the servicing cable could also be used. Another MMSE item labeled Orbiter/Payload Service Cable and J-Box (05-01) would be applicable to multiple payload configurations in the payload bay if some weight reduction modifications to the approach could be incorporated.

The MMSE Purge System (06-03) could be used by the DoD payload DMSP to satisfy purging and cooling requirements.

Table 2-3 summarizes the potential applicability of launch site MMSE to DoD payloads. Of the 19 MMSE items studied, 13 were determined to be potentially applicable to DoD. The applicability of the remaining six items could not be determined at this time. These equipment items are fluid service units and further definition of the DoD satellites is needed to determine whether or not the services are required.

Of the 13 launch site MMSE items applicable to DoD payloads, six are STS-peculiar and therefore are expected to be new developments. These are the containers (items -10 and -11), the transponders (items -39 and -41), the mechanical payload simulator (item -07), and the interface verification equipment (IVE). Each of these items is recommended for consideration as potential NASA/DoD ancillary equipment.

The remaining seven launch site MMSE items applicable to DoD payloads (platforms, handling fixtures, slings, stands, and service units) are expected to be in existence at the time the STS is phased in as the payload launch vehicle. When the STS payload launch site facilities are better defined, these seven items should be reviewed again to see if the existing equipments are applicable to and compatible with the STS facilities.

Although a justification task was not a part of this study, it is expected that DDT&E costs would be lowered for both DoD and NASA by sponsoring common interface equipments (MMSE). In addition, there are potential advantages for system operators. Orbiter turnaround costs and payload installation time could be saved by the use of common on-line interface equipment. The use of a standard interface between the IUS and the NASA and DoD payloads would greatly facilitate the IUS operation with multiple payloads.

Table 2-3. Summary, Launch Site MMSE Applicable to DoD Payloads

MMSE		Total No. Of Payloads	APPLICABILITY			
Item Number	Name		KSC	VAFB	Also Used In Factory(1)	First Used
KMA-MH-06	Access Platform, Spacecraft Assembly Stand, Vertical	9	Yes	Yes	Yes	FY 81
KMA-MH-10	Container, Payload	9	Yes	No	Yes	FY 81
KMA-MH-11	Container, Payload Element	10	Yes	Yes	Yes	FY 80
KMA-MH-19	Fixture, Payload Handling	2	Yes	Yes	Yes	FY 82
KMA-MH-27	Sling Set, Multipurpose	12	Yes	Yes	Yes	FY 80
KMA-MH-34	Stand, Spacecraft Assembly, Vertical	12	Yes	Yes	Yes	FY 80
KMA-MH-39	Transporter, Payload Container, Horizontal	2	Yes	Yes	Yes	FY 82
KMA-MH-41	Transporter, Payload Container, Vertical/ Element	9	Yes	No	Yes	FY 81
KMA-MT-07	Simulator, Payload, Mechanical	N/A <sup>(2)</sup>	Yes	Yes	Yes	FY 80

(1) Same, or similar equipment required for factory processing.

(2) Item is used to verify other support equipment and is not applicable to specific payloads.

Table 2-3. Summary, Launch Site MMSE Applicable to DoD Payloads (Cont'd)

MMSE		Total No. Of Payloads	APPLICABILITY			
Item Number	Name		KSC	VAFB	Also Used In Factory <sup>(1)</sup>	First Used
KMB-AH-30	Stand, Work, Payload Assembly/Test Horizontal	11	Yes	Yes	Yes	FY 81
KMB-MS-01	Set, Hydrazine Service	12	Yes	Yes	Yes	FY 80
KMB-MS-02	Set, Instrument Gas Service	(TBD)				
KMB-MS-03	Set, Liquid Helium Service	(TBD)				
KMB-MS-04	Set, Liquid Hydrogen Service	(TBD)				
KMB-MS-09	Cart, Payload Purge	3	Yes	Yes	Yes	FY 81
KMB-SS-03	Set, Liquid Nitrogen Service	(TBD)				
KMB-SS-04	Set, Liquid Neon Service	(TBD)				
KMB-SS-05	Set, Liquid Oxygen Service	(TBD)				
(None)	Interface Verification Equipment (IVE)	12	Yes	Yes	Yes	FY 80

(1) Same, or similar equipment required for factory processing.

### 3. MULTI-MISSION SUPPORT EQUIPMENT (MMSE) LISTS

This section presents the MMSE lists selected for use in this study. The selections were made by Aerospace Corporation and approved by NASA. Guidance in selecting the equipments was obtained from MSFC (Wilbur Thompson) in the case of the on-line (or airborne) MMSE and from KSC (Charles Hart and John Twigg) for launch site MMSE. On-line MMSE items to be considered were limited to those on which MSFC was recommending further effort in FY 76 (see Reference 18). Only MMSE applicable to automated payloads was considered. MMSE applicable to sortie payloads only was omitted since the DoD mission model contained no sortie missions. The launch site MMSE selected was that identified by KSC as either Category A (required item) or Category B (proposed item).

#### 3.1 LAUNCH SITE MMSE LIST SELECTED FOR STUDY

Table 3-1 presents the launch site MMSE GSE ancillary equipment which was selected for consideration in this study.

#### 3.2 ON-LINE MMSE LIST SELECTED FOR STUDY

Table 3-2 presents the on-line MMSE list selected for consideration in this study.



Table 3-1. Launch Site MMSE, GSE Ancillary Equipment  
To Be Considered in Study, KSC Recommended  
MMSE Equipment List

KSC Grouping	Martin Item Number	Name
KSC CATEGORY A MMSE ITEMS		
1	KMA-MH-10 KMA-MH-11	Container, Payload Container, Payload Element
2	KMA-MH-39 KMA-MH-41	Transporter, Payload Container, Horizontal Transporter, Payload Container, Vertical/ Element
3	KMA-MH-19	Fixture, Payload Handling
4	KMA-MT-07	Simulator, Payload, Mechanical
KSC CATEGORY B MMSE ITEMS		
1	KMB-MS-03 KMB-MS-04 KMB-SS-03 KMB-SS-04 KMB-SS-05	Set, Liquid Helium Service Set, Liquid Hydrogen Service Set, Liquid Nitrogen Service Set, Liquid Neon Service Set, Liquid Oxygen Service
2	KMB-AH-30	Stand, Work, Payload Assembly/Test, Horizontal
3	KMB-MS-02 KMB-MS-09	Set, Instrument Gas Service Cart, Payload Purge
4	KMB-MS-01	Set, Hydrazine Service
5	KMA-MH-06  KMA-MH-27 KMA-MH-34	Access Platform, Spacecraft Assembly Stand, Vertical  Sling Set, Multipurpose Stand, Spacecraft Assembly, Vertical
JSC MMSE ITEM		
	IVE	Interface Verification Equipment (See Rockwell International Study)

Table 3-2. On-Line MMSE To Be Considered In Study  
MSFC Recommended On-Line MMSE List  
Automated Payloads Only

GROUP I MMSE ITEMS - RECOMMENDED FOR FY 77 START

1. PSS
2. Transportation System for Outsized Payloads (Incl. Canister)
3. Contamination Monitor and Control

GROUP II MMSE ITEMS - RECOMMENDED FOR FY 78 START

1. Payload Interface Adapter (PIA-3)
2. Payload Interface Adapter (PIA-1)
3. Payload Interface Adapter (PIA-2)
4. Payload Services Plate (PSP-2)
5. Separation Latch and Push-Off Assembly (SLP-1)
6. Payload Services Plate (PSP-1)
7. Payload Mounting Beam (XPMB-1)
8. Payload Mounting Beam (XPMB-2)
9. Payload Interface Adapter (XPIA-1)
10. Payload Mounting Beam (XPMB-3)
11. Payload Spacer (XPLS-3)
12. Payload Spacer (XPLS-2)
13. Payload Spacer (XPLS-4)
14. General Purpose Platform

GROUP II MMSE ITEMS - OTHER PRIME CANDIDATES FOR FY 78 START

1. Auxiliary Power Unit
2. TV Camera (1024 Line)
3. TV Camera (Commercial)
4. Earth/Moon/Sun Sensor

GROUP III MMSE ITEMS TO BE STUDIED IN FY 76

1. Orbiter/Payload Service Cable and J-Box Assembly (Automated)
2. Payload Umbilical Cabling (Automated)
3. IUS Deployed Payload Cable and J-Box Assembly
4. Payload Umbilical Cabling (IUS)
5. Payload Service Cable (IUS)
6. Orbiter/Payload Service Lines and Connector Plate Assembly
7. Orbiter/IUS Deployed Payload Service Lines
8. Payload Service Lines Routed via IUS (IUS-Auto)
9. Payload Umbilical Support (PUS-1)
10. Protective Shroud
11. RTG Cooling Unit
12. Extendible Boom #1
13. Structural Cradle/Tilt Table

#### 4. DOD PAYLOAD AND STS/PAYLOAD INTERFACE DATA

The DoD payload information used in the Ancillary Equipment Study was taken from two sources. The classified DoD Space Mission Model (Revision 4) lists data describing the gross satellite characteristics officially sanctioned for use in this study. The DoD STS/Payload Interface Studies have been made using payload information which differs from that contained in the mission model. The latter data are unclassified and generally correspond to current satellite characteristics. Six DoD satellites (DSCS-II, FSC, DSP, GPS, SOSS, and DMSP) were studied.

The STS payload interface equipment needs were derived from the contractor study information. If the need for the equipment was expected to be affected by the changes in satellite characteristics exhibited in the DoD Space Mission Model, the study result was altered to account for this effect.

The DoD STS/payload interface contractors studied on-line integration and the DoD needs for the payload changeout room. No consideration was given to the need for GSE (launch site MMSE) in these studies. The assessment of the utility of the launch site MMSE was thus limited to consideration of the gross characteristics and potential requirements for the DoD payloads. This was appropriate since only verbal descriptions (as opposed to descriptions with numerical values for equipment characteristics) were available for most of the launch site MMSE.

Although the STS/Payload Interface Study contractors for DoD recommended some equipments for the payload specialists function at the Payload Specialist Station (PSS) in the orbiter, these were not assessed as a part of this effort. The PSS equipments were eliminated because of the DoD guidance directing a minimal payload/STS interface which was issued subsequent to the contractors' studies and applies to the near-term DoD STS payloads.

#### 4.1 DOD PAYLOAD DATA SHEETS

As a part of the Ancillary Equipment Study, a DoD Payload Data Sheet format was derived and the data available from the DoD STS/payload interface contractor studies (Ref. 6 through 10) were summarized on these data sheets for use in this payload interface study. The data sheets are on file at Aerospace. The interface equipment needs derived in the references are summarized in Section 4.2.

#### 4.2 DOD ON-LINE ANCILLARY EQUIPMENT NEEDS LIST

The on-line ancillary equipment needs for the six DoD payloads studied by DoD contractors, plus the radioisotope thermoelectric generator (RTG), are checked off in Table 4-1. The equipment is listed as well as the DoD study in which it is applicable. The satellites to which each of the equipments apply are indicated on the table. As can be seen from the table, many of the equipments apply to several satellites, suggesting that there is a potential for common equipments across several of the satellite programs.

Table 4-1. Summary of DoD On-Line Ancillary Equipment Needs  
(From DoD STS/Payload Interface Contractor Study  
Reports)(1)

Equipment or Kit	Potential Or Required	DoD Study		Interface Study Satellite With Requirement						
		R.I. (2)	MDAC	DSCS-II	DSP	FSC	DMSP	SOSS	RTG	GPS
<u>Tug Interface</u>										
OOS (Tug) Adapter	P		1973							
S/C Retrieval Ring/Adapter	P		1973	X	X	X				
OOS Electrical Interface and Digit Interleaver	P		1973							
Recovery Control Unit (Tug)	P		1973	X	X	X				
IUS/Payload Adapters	R		1974			X			X	
Orbiter/Payload Cradle or Pallet	R	1975		X	X	X	X	X	X	X
<u>Cabling and Associated Equipment</u>										
Flight Umbilical Separation and Connect/Disconnect at Separation Interface	R	1975	1974	X	X	X	X	X		X
Avionics Cabling and Umbilical	R	1975	1973/1974	X	X	X	X	X	X	X
Power Cabling	R	1975	1974	(3)	(3)	(3)	X	X	X	X
Junction Box (Field Joint)	R	1975		X	X	X	X	X	X	X
<u>Fluid Support</u>										
T-0 Umbilical (Also T-0 GSE Umbilical Panel)	R	1975	1973	X	X	X	X	X	X	
GN <sub>2</sub> Supply	R	1975					X			
Ground Fluids		1975		(3)	(3)	(3)				
Water									X	
GN <sub>2</sub>							X			
Flight Fluids	R	1975		(3)	(3)	(3)				
<u>Power</u>										
Power Supply	R		1975				X	X		
Power Regulator	R	1975(4)								X
Power Conditioning	R	1975					X	X		

(1) See References

(2) Assessment of MDAC studies except as noted.

(3) IUS provisions (R.I. assessment)

(4) GPS study.

ORIGINAL PAGE IS  
OF POOR QUALITY

Table 4-1. Summary of DoD On-Line Ancillary Equipment Needs (Cont'd)  
(From DoD STS/Payload Interface Contractor Study Reports)<sup>(1)</sup>

Equipment or Kit	Potential Or Required	DoD Study		Interface Study Satellite With Requirement						
		R.I. <sup>(2)</sup>	MDAC	DSCS-II	DSP	FSC	DMSP	SOSS	RTG	GPS
<u>Payload Specialist Station Equipment</u>	P	1975		X	X	X	X	X	X	
Payload Downlink Test	P		1974 <sup>(3)</sup>		X					
PCM Test	P		1974 <sup>(3)</sup>		X					
Cargo Bay Receiving Antennas	P	1975 <sup>(4)</sup>								X
Spacecraft Power	P		1974 <sup>(3)</sup>		X					X
Software	P		1974 <sup>(3)</sup>		X					
Checkout Using PCM Link & CRT Scenario	P	1975 <sup>(4)</sup>			X					X
Safety Support Equipment	R		1974	X	X		X	X		
				X	X	X				
<u>Mission Specialist Station Equipment</u>	P	1975		X	X	X	X	X	X	
Control Panel	R	1975 <sup>(4)</sup>	1974 <sup>(5)</sup>	X	X	X				X
<u>Electrical Equipments and Software</u>										
Electrical Ground Isolation	R	1975					X	X		
Electrical Control and Distribution Assembly (ECDA)	R		1974 <sup>(5)</sup>	X	X	X	X	X		
Software	R		1974 <sup>(5)</sup>	X	X	X				
<u>RTG Cooling Equipment</u>										
Heated Orbiter Dumpline	P		1974						X	
Payload Provided Orbiter MDM	P		1975						X	
Boiler, Heat Exchange Pumps, etc.	P		1975						X	
Tanks and Structure			1975						X	
Additional Orbiter Heat Exchanger and Connector <sup>(6)</sup>	P	1975							X	
RTG Encapsulator	P		1975							
Shroud	P		1974		X					X
c. g. Ballast	R	1975					X	X		
Payload Retrieval (End Effector, etc.)	P	1975 <sup>(4)</sup>								X

(1) See References

(2) Assessment of MDAC studies except as noted.

(3) ORT test.

(4) GPS study.

(5) C/W

(6) Replaces above two items.

ORIGINAL PAGE IS  
OF POOR QUALITY

## 5. POTENTIAL DOD APPLICATIONS

### 5.1 ON-LINE MMSE LISTS FOR APPLICATION ANALYSIS

There are two conditions which it is necessary to meet in order for a MMSE item to be carried into the application analysis task and the assessment of its applicability to DoD payloads required. The first condition is that the equipment be a candidate which could satisfy a DoD interface need. These interface needs are listed in Section 4.2. The second condition is that the MMSE item be recommended by NASA for further effort, either additional study or definition and new start. Table 5-1 lists the MMSE described in the MMSE Catalog (Reference 1) and indicates which of the conditions each equipment satisfies. Each equipment which has a "yes" in both of the two right-hand columns was assessed for applicability to DoD payloads. If the equipment was needed by DoD but not on the NASA proposed list, it would normally also be assessed to see if its application was general enough to make a recommendation to NASA that the equipment be given further consideration.

Table 5-2 relates the DoD interface equipment need from Table 4-1 to the candidate NASA MMSE listed in Table 5-1. Both Tables 5-1 and 5-2 again indicate the potential commonality between DoD ancillary equipment needs and MMSE under consideration by NASA. In Table 5-2 the "Tug-Only" equipments have been eliminated since they apply to the far-term DoD payloads which were not considered in this study.

Table 5-1. Ancillary Equipment List Status Prior To Application Analysis

MMSE Catalog List<sup>(1)</sup>

Equipment	Catalog Page <sup>(1)</sup>	Candidate For DoD Interface Need	On NASA MMSE List <sup>(2)</sup>
<u>Transportation, Handling, and Servicing Equipment</u> <sup>(3)</sup>			
Payload Container	II-2	Yes	Yes
Payload Container Transporter	II-4	Yes	Yes
Payload Handling Fixture	II-6	Yes	Yes
Payload Mechanical Simulation Set	II-8	---	Yes
Interface Verification Equipment	(4)	Yes	Yes
<u>Candidate STS/Payload Interface Equipment</u>			
Miniaturized Pointing Mount	III-2	---	---
Payload Specialist Station	III-5	Yes	Yes
Transportation System for Out-sized Payloads	III-9	Yes	Yes
Real Time Contamination Monitor	III-12	---	Yes
28 $\pm$ 1% VDC Regulator	4	Yes	---
Auxiliary Power Unit	9	Yes	Yes
DC-DC Converter - 5 VDC	14	Yes	---
Star Tracker (0.5 arc sec)	19	---	---
Star Tracker (10 arc sec)	24	---	---
Sun Sensor	29	---	---

- (1) Reference 1.
- (2) Recommended by KSC or MSFC for further effort.
- (3) KSC Catagory A items.
- (4) Not in Martin Marietta Catalog.



Table 5-1. Ancillary Equipment List Status Prior To Application Analysis (Cont'd)

MMSE Catalog List<sup>(1)</sup>

Equipment	Catalog Page <sup>(1)</sup>	Candidate For DoD Interface Need	On NASA MMSE List <sup>(2)</sup>
<u>Candidate STS/Payload Interface Equipment (Cont'd)</u>			
Horizon Sensor	34	---	---
Inertial Measurement Unit (IMU)	39	---	---
Mini/Micro Computer	44	(3)	(3)
Payload Workstations	49	---	---
TV Camera (1024 Line)	54	---	Yes
TV Camera (Commercial)	59	---	Yes
Earth/Moon/Sun Sensor	64	---	---
Radiation Detector	69	---	---
Orbiter/Payload Service Cabling and "J" Box (Orbiter Deployed)	74	Yes	Yes
Payload Umbilical Cabling (Orbiter Deployed)	79	Yes	Yes
Orbiter/Payload Service Cabling and "J" Box (IUS Deployed)	84	Yes	Yes
Payload Umbilical Cabling (IUS Deployed)	89	Yes	Yes
Payload Service Cable (IUS)	94	Yes	Yes
RTG Cooling Unit	99	Yes	Yes

(1) Reference 1.

(2) Recommended by KSC or MSFC for further effort.

(3) Part of PSS.

Table 5-1. Ancillary Equipment List Status Prior To Application Analysis (Cont'd)

MMSE Catalog List<sup>(1)</sup>

Equipment	Catalog Page <sup>(1)</sup>	Candidate For DoD Interface Need	On NASA MMSE List <sup>(2)</sup>
<u>Candidate STS/Payload Interface Equipment (Cont'd)</u>			
Payload Shroud	104	Yes	Yes
Purge System	109	Yes	(3)
Orbiter/Payload Fluid Service Lines (Orbiter Deployed)	114	Yes	Yes
Pallet Mounted Service Lines	119	---	---
IUS Deployed Payload Fluid Service Lines	124	Yes	Yes
Payload Fluid Lines Routed via IUS/Cradle	129	Yes	Yes
Pallet Interface Connector Panel	134	---	---
Payload Interface Adapter (PIA-1) (Tug and IUS)	139	Yes	Yes
Payload Interface Adapter (PIA-2) (Tug and IUS)	144	Yes	Yes
Payload Interface Adapter (PIA-3) (Tug and IUS)	149	Yes	Yes
Payload Interface Adapter (PIA-4) (Tug and IUS)	154	Yes	---
Payload Interface Adapter (PIA-5) (Tug and IUS)	159	Yes	---
Payload Interface Adapter (XPIA-1) (Tug and IUS)	164	Yes	Yes

(1) Reference 1.

(2) Recommended by KSC or MSFC for further effort.

(3) On sortie only list.

Table 5-1. Ancillary Equipment List Status Prior To Application Analysis (Cont'd)

MMSE Catalog List<sup>(1)</sup>

Equipment	Catalog Page <sup>(1)</sup>	Candidate For DoD Interface Need	On NASA MMSE List <sup>(2)</sup>
<u>Candidate STS/Payload Interface Equipment (Cont'd)</u>			
Payload Mounting Beam (PMB-1) (Tug)	169	---	---
Payload Mounting Beam (PMB-2) (Tug)	174	Yes <sup>(3)</sup>	---
Payload Mounting Beam (PMB-3) (Tug)	179	---	---
Payload Mounting Beam (XPMB-1)	184	Yes	Yes
Payload Mounting Beam (XPMB-2)	189	Yes	Yes
Payload Mounting Beam (XPMB-3)	194	Yes	Yes
Payload Spacer (PLS-2) (Tug)	199	---	---
Payload Spacer (PLS-3) (Tug)	204	---	---
Payload Spacer (PLS-4) (Tug)	209	Yes <sup>(3)</sup>	---
Payload Spacer (PLS-5) (Tug)	214	---	---
Payload Spacer (PLS-6) (Tug)	219	Yes	---
Payload Spacer (XPLS-2)	224	Yes	Yes
Payload Spacer (XPLS-3)	229	Yes	Yes
Payload Spacer (XPLS-4)	234	Yes	Yes

(1) Reference 1.

(2) Recommended by KSC or MSFC for further effort.

(3) For use with IUS.

Table 5-1. Ancillary Equipment List Status Prior To Application Analysis (Cont'd)

MMSE Catalog List<sup>(1)</sup>

Equipment	Catalog Page <sup>(1)</sup>	Candidate For DoD Interface Need	On NASA MMSE List <sup>(2)</sup>
<u>Candidate STS/Payload Interface Equipment (Cont'd)</u>			
Power Hinge and Latch Assembly (PHL-1)	239	Yes	---
Spin Separation Module (SS-1)	244	Yes	---
Payload Docking Kit (PDK-1)	249	Yes	---
Payload Docking Kit (PKD-2)	264	Yes	Yes
Payload Services Plate (PSP-1)	259	Yes	Yes
Payload Services Plate (PSP-2)	264	Yes	Yes
IUS/Tug Adapter (ITA-1)	269	Yes	---
Separation Latch and Push-Off Assembly (SLP-1)	274	Yes	Yes
Payload Umbilical Support (PUS-1)	279	Yes	Yes
Automated Payload Support (APS-1)	284	Yes	(3)
Swing/Tilt Table (On-Orbit Service)	289	---	---
Special Pallet No. 1	294	---	---
Special Pallet No. 2	299	---	---
Removable Pallet Floor No. 1	304	---	---
Removable Pallet Floor No. 2	309	---	---

(1) Reference 1.

(2) Recommended by KSC or MSFC for further effort.

(3) Not certain.

Table 5-1. Ancillary Equipment List Status Prior To Application Analysis (Cont'd)

MMSE Catalog List<sup>(1)</sup>

Equipment	Catalog Page <sup>(1)</sup>	Candidate For DoD Interface Need	On NASA MMSE List <sup>(2)</sup>
<u>Candidate STS/Payload Interface Equipment (Cont'd)</u>			
General Purpose Platform No. 1	314	Yes	Yes
General Purpose Platform No. 2	319	Yes	Yes
Extendible Boom No. 1	324	---	Yes
Extendible Boom No. 2	329	---	---
Extendible Boom No. 3	334	---	---
Erection/Deployment Mechanism No. 1	339	---	---
Erection/Deployment Mechanism No. 2	344	---	---
Erection/Deployment Mechanism No. 3	349	---	---
Module Exchange Mechanism (Tug)	354	Yes	---
Structural Cradle/Tilt Table	TBD	Yes	Yes

(1) Reference 1.

(2) Recommended by KSC or MSFC for further effort.

Table 5-2. On-Line MMSE List for Application Analysis  
To DoD Payloads

No.	Equipment Title		Catalog Pages
	DoD Need	Candidate NASA MMSE	
1.0	IUS Payload Support	Payload Interface Adapter (PIA-1, 2, 3, 4, 5) Payload Interface Adapter (XPJA-1) Payload Mounting Beams (XPMB-1, 2, 3) Payload Spacers (XPLS-2, 3, 4) Payload Services Plate (PSP-1, 2) Separation Latch and Pushoff Assembly (SLP-1)	139-163 165-168 184-198 224-238 259-268 274-278
2.0	Orbiter Payload Support		
2.1	Cradle or Pallet	Structural Cradle/Tilt Table Automated Payload Support (APS-1) General Purpose Platform	TBD 284-288 314-323*
2.2	Shroud	Payload Shroud	104-108
2.3	C. G. Ballast		
2.4	Retrieval Mechanism End Effector etc.		

\* Also see MSFC MMSE briefing chart data.

Table 5-2. On-Line MMSE List for Application Analysis  
To DoD Payloads (Cont'd)

No.	Equipment Title		Catalog Pages
	DoD Need	Candidate NASA MMSE	
3.0	RTG Cooling System		
3.1	Heated Orbiter Dumpline		
3.2	Payload Provided Orbiter MDM		
3.3	Boiler, Heat Exchange Pumps, etc. Tanks & Structure	RTG Cooling Unit	99-103
3.4	Additional Orbiter Heat Exchange & Connector	RTG Cooling Unit	99-103
3.5	Encapsulator		
4.0	Electrical/Avionics Support		
4.1	Avionics Cabling	Orbiter Payload Service Cabling and J-Box (Orbiter Deployed)	74-78
4.2	Power Cabling	Orbiter Payload Service Cabling and J-Box (IUS Deployed)	84-88
4.3	Junction Box (Field Joint)		

Table 5-2. On-Line MMSE List for Application Analysis  
To DoD Payloads (Cont'd)

No.	Equipment Title		Catalog Pages
	DoD Need	Candidate NASA MMSE	
4.4	Avionics Umbilical	Payload Umbilical Cabling (Orb. Dep'd) Payload Umbilical Cabling (IUS Dep'd) Payload Service Cable (IUS)	79-83 89-93 94-98
4.5	Flight Umbilical	Payload Umbilical Support (PUS-1)	279-283
4.6	Power Supply	Auxiliary Power Unit	9-13
4.7	Power Supply Control & Display	(1)	
4.8	Electrical Control and Distrib. Assy. (C/W)		
4.9	Software (C/W)		
5.0	Fluid Support		
5.1	GN <sub>2</sub> Supply	IUS Deployed Payload Fluid Service Lines Payload Fluid Lines Routed via IUS/Cradle Purge System	124-128 129-133 109-113
5.2	Ground Fluids	Orbiter/Payload Fluid Service Lines (Orbiter Deployed)	114-118

(1) Display could use PSS equipment.



Table 5-2. On-Line MMSE List for Application Analysis  
To DoD Payloads (Cont'd)

No.	Equipment Title		Catalog Pages
	DoD Need	Candidate NASA MMSE	
5.3	Water	IUS Deployed Payload Fluid Service Lines Payload Fluid Lines Routed via IUS/Cradle	124-128 129-133
5.4	GN <sub>2</sub> Flight Fluids	Orbiter/Payload Fluid Service Lines (Orbiter Deployed) IUS Deployed Payload Fluid Service Lines Payload Fluid Lines Routed via IUS/Cradle	114-118 124-128 129-133
6.0	PSS Equipment	PSS Equipment	III-5-III-8
6.1	Telemetry Test		
6.2	Spacecraft Power		
6.3	Software		
6.4	Spacecraft Monitor (See Scenario)		
6.5	Checkout <sup>(1)</sup>		
6.6	CRT for MSS/PSS		
7.0	MSS Equipment	PSS Equipment	III-5-III-8
7.1	Control Panel		

(1) Use PCM hardwire link.

## 5.2 IUS/PAYLOAD SUPPORT

### 5.2.1 Summary

The applicability of IUS/payload support equipments to the DoD payloads considered in this study is summarized in Section 2. The Payload/IUS Interface Study is reported in Section 6. The main findings of this study are listed below.

1. Multiple GPS payloads sharing one IUS flight are planned and can use MMSE IUS/payload interface equipments.
2. For transitioning DoD payloads it is feasible to use MMSE to standardize the payload/IUS interface. This standardization of the interface furnishes a new justification for payload/IUS support MMSE. With this standardization comes the capability to fly payloads either singly or in multiples while maintaining the same payload interface. Thus the DoD payloads can be combined with each other or with non-DoD payloads up to (a) the limits of the performance capability of the IUS, (b) the load carrying capability of the MMSE, and (c) the payload volume available forward of the IUS as it is mounted in the orbiter payload bay.
3. It is recommended that NASA consider modification of Payload Spacer XPLS-3 to a larger diameter to accommodate DoD payloads efficiently in a tandem mounting.
4. It is recommended that NASA consider a payload spacer of the XPLS-3 type but of a shorter length to accommodate a combination of the DSP and DSCS payloads sharing a IUS flight.
5. It is recommended that NASA consider modification of the side-by-side payload beam XPMB-1 to a smaller diameter to obtain adequate rattlespace in the payload bay. Three or four side-by-side payloads (instead of two) should also be considered.
6. It is recommended that NASA consider MMSE providing for tandem mounting (of up to three decks) of side-by-side payloads mounted on payload beam XPMB-1 (modified).

The MMSE data sheets listing the satellites which are potential DoD users are presented in Section 5.2.2.

#### 5.2.2 MMSE Data Sheets

MMSE Data Sheets pertaining to IUS/payload support are presented on pages 5-15 through 5-34.

### 5.3 ORBITER PAYLOAD SUPPORT

#### 5.3.1 Summary

The DoD interface study contractors considered only unique payload supports in the orbiter payload bay. It was also assumed that the remote manipulator system and payload support arms would be adequate for payload deployment and/or retrieval when required. If one or more of the DoD payload projects required that the payload be deployable under 1 g conditions (for test purposes), additional equipments would be required; however, no MMSE is proposed for this function.

The DMSP and one other DoD satellite would use the General Purpose Platform for support in the orbiter payload bay. The General Purpose Platform could also support the RTG Cooling Unit during flight. The General Purpose Platform is therefore recommended as a potential common MMSE item for DoD and NASA.

A Center of Gravity Ballast Kit, a non-MMSE item, is required for the SOSS satellite. An end effector on the remote manipulator system capable of connecting an umbilical to the payload is needed for the DMSP and SOSS satellite projects. This also is a non-MMSE interface equipment.

The study reported in Reference 7 called out a shroud for the DSP satellite while it was mounted in the payload bay as a potential requirement. It is possible that the shroud would not be needed if local dust covers protected the individual critical areas on the spacecraft and other means were used to either reduce the sound pressure level or requalify the spacecraft components for the increased sound pressure level. The use of a common shroud has additional advantages which should be considered. For instance, it affords protection from contaminants from flight sharing payloads and would protect the orbiter payload from reentry debris during abort. Protection would also be provided against orbiter RCS plume impingement and contamination of the spacecraft.

It is recommended that the shroud be studied further as a MMSE item. The possibility of use of the same shroud with other payloads such as the DMSP (no IUS) and the options to make the shroud modular and capable of return and reuse should be studied.

The MMSE Data Sheets listing the satellites to which orbiter payload support equipment are applicable are presented in Section 5.3.2.

#### 5.3.2 MMSE Data Sheets

MMSE Data Sheets pertaining to orbiter payload support are presented on pages 5-35 through 5-51.

## IUS/Payload Support MMSE Data Sheet

1. IDENTIFICATION NO. 330-03-08-01-02

2. NAME Payload Interface Adapter (PIA-2)

3. DATE \_\_\_\_\_

4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☒                      AUTO W IUS ☒  
    AUTO W TUG ☒                      CREW RELATED ☐                      OTHER ☐

### 5. JUSTIFICATION

Requirement:      Provide one standard structural and services interface on payloads 54 in to 86 in diameter to allow interchangeable mating with other standardized interfacing equipment (MMSE).

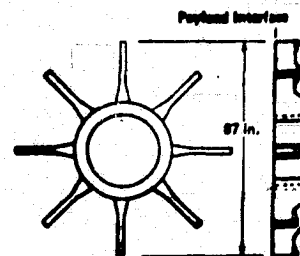
### 6. APPLICATION

POTENTIAL USERS GPS

7. ALTERNATIVE SOLUTION IF NOT MMSE Payloads could incorporate the necessary interfacing hardware in the payload design, which is Martin's recommendation.

### 8. EQUIPMENT DESCRIPTION

- Permanently attached to payload structure
- Eight fittings at ends of beams interface with the SLP-1 assemblies mounted on PMB-1, -2, XPMB-1, and -2.
- Mounts PSP-2 plate which supports payload connector halves, which mate with those supported by PSP-1, mounted on the PMBs.
- Mounts PDK-2 if payload is to be retrieved
- Weight - 57 lb.
- Conventional aluminum construction



9. REMARKS Standardization of payload interfaces is desired in order to accommodate many of the IUS and Tug multiple payload flights. IUS - 120 inch diameter interface with 8 unevenly spaced hard points; Tug - 176 inch diameter interface with 8 evenly spaced hard points.

### 10 RATIONALE FOR APPLICATION

The Payload Interface Adapter (PIA-2) is mounted permanently on the payload and provides an interface with the eight Separation Latch and Push-Off Assemblies (SLP-1). Martin recommends the alternate approach (see Item 7 of this data sheet).

ORIGINAL PAGE IS  
OF POOR QUALITY

## IUS/Payload Support MMSE Data Sheet

1. IDENTIFICATION NO. 330-03-08-01-03
2. NAME Payload Interface Adapter (PIA-3)
3. DATE \_\_\_\_\_
4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☒                      AUTO W IUS ☒  
    AUTO W TUG ☒                      CREW RELATED ☐                      OTHER ☐

### 5. JUSTIFICATION

Requirement: Provide one standard structural and services interface on payloads 86 to 131 in diameter to allow interchangeable mating with other standardized interfacing equipment (MMSE).

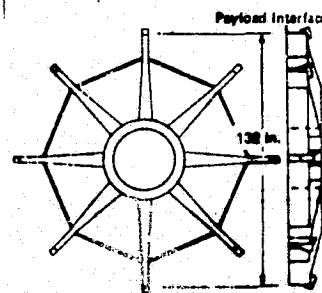
### 6. APPLICATION

POTENTIAL USERS DSCS-II, FSC, DSP

7. ALTERNATIVE SOLUTION IF NOT MMSE Payloads can incorporate the necessary interfacing hardware in the payload design, which is Martin's recommended approach.

### 8. EQUIPMENT DESCRIPTION

- Permanently attached to payload structure
- Eight fittings at ends of beams interface with the SLP-1 assemblies mounted on PMB-2 and XPMB-2
- Mounts PSP-2 plate which supports payload connector halves, which mate with those supported by PSP-1, mounted on the PMBs
- Mounts PDK-2 if payload is to be retrieved
- Weight = 85 lb
- Conventional aluminum construction



9. REMARKS Standardization of payload interfaces is desired in order to accommodate many of the IUS and Tug multiple payload flights. IUS - 120 in diameter interface with 8 unevenly spaced hard points; Tug - 176 in diameter interface with 8 evenly spaced hard points.

### 10. RATIONALE FOR APPLICATION

The Payload Interface Adapter (PIA-3) is mounted permanently to the payload and provides an interface with the eight Separation Latch and Push-Off Assemblies (SLP-1). The alternate solution is recommended by Martin (see Item 7. this Data Sheet).

## IUS/Payload Support MMSE Data Sheets

1. IDENTIFICATION NO. 330-03-08-02-02  
 2. NAME Payload Mounting Beam (PMB-2)  
 3. DATE \_\_\_\_\_  
 4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☒                      AUTO W IUS ☒  
    AUTO W TUG ☒                      CREW RELATED ☐                      OTHER ☐

### 5. JUSTIFICATION

Requirement:      Interface individually-mounted payloads (during both delivery and retrieval) with the Tug, or with other standardized interfacing equipment (MMSE)

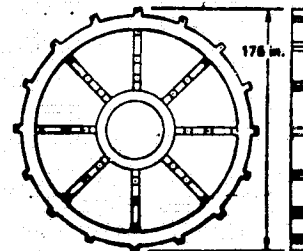
### 6. APPLICATION

POTENTIAL USERS LEO<sup>(1)</sup>, also flights which include multiple payloads using Payload Spacer PLS-4 (e.g., two DSCS-II satellites or FSC and DSCS-II satellites) on IUS, see PLS-4 Sheet.

7. ALTERNATIVE SOLUTION IF NOT MMSE Equivalent item could be supplied by the payloads, or by the Tug or IUS program.

### 8. EQUIPMENT DESCRIPTION

- Supports individually-mounted payloads using PIA-1, -2, -3, or -4, or the interface adapter incorporated in the payload design.
- Mounts one set of SLP-1 assemblies at any of four diameters and one PSP-1 assembly.
- Mounts PDK-1 docking kit when payload retrieval is required.
- Conventional aluminum construction.
- Weight = 373 lb.
- Mounts directly on Tug interface, on any PLS (tandem payloads) or on the APS (automated payloads).



9. REMARKS Tug - 176 inch diameter interface with 8 evenly spaced hard points.

(1) Any Low Earth Orbit (LEO) DoD payload which would mount on APS-1.

## IUS/Payload Support MMSE Data Sheets

### Payload Mounting Beam (PMB-2), 330-03-08-02-02 (Cont'd)

#### 10. RATIONALE FOR APPLICATION

The Payload Mounting Beam (PMB-2) must be used with the large 176-inch diameter payloads (with DSCS-II, FSC). The beam is used to support the satellite directly (Martin recommended approach) or the payload interface adapter (PIA) which is permanently mounted to the payload, or the interface adapter incorporated in the payload design. The beam also supports the separation latch and push-off assembly (SLP-1) which is used to deploy the payload.



## IUS/Payload Support MMSE Data Sheets

1. IDENTIFICATION NO. 330-03-08-02-04

2. NAME Payload Mounting Beam (XPMB-1)

3. DATE \_\_\_\_\_

4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☐                      AUTO W IUS ☒  
    AUTO W TUG ☐                      CREW RELATED ☐                      OTHER ☐

**5. JUSTIFICATION**

Requirement: Interface two payloads, in side-by-side configuration, with the IUS or with other standardized interfacing equipment (MMSE). Primary use is with multiple payloads.

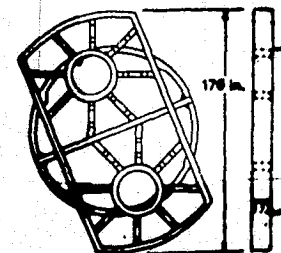
**6. APPLICATION**

POTENTIAL USERS GPS

7. ALTERNATIVE SOLUTION IF NOT MMSE Equivalent item could be supplied by the payloads, or by the IUS program.

**8. EQUIPMENT DESCRIPTION**

- Supports two payloads using PIA-1 or -2 or the interface adapter incorporated in the payload design.
- Mounts two sets of SLP-1 assemblies on either of two diameters, and two PSP-1 assemblies.
- Conventional aluminum construction
- Weight = 178 lb
- Mounts directly on IUS interface, or any XPLS (tandem payloads).



9. REMARKS IUS - 120 in diameter interface with eight unevenly spaced hard points.

## IUS/Payload Support MMSE Data Sheets

### Payload Mounting Beam (XPMB-1), 330-03-08-02-04 (Cont'd)

#### 10. RATIONALE FOR APPLICATION

The payload mounting beam (XPMB-1) is used to support two payloads side-by-side and connects to the payload (Martin recommended approach) or the payload interface adapter (PIA) which is permanently mounted to the payload. The beam also supports the separation latch and push-off assembly (SLP-1) which is used to deploy the payload.

#### 11. MODIFICATION TO CONSIDER

Decrease 176-inch diameter to allow sufficient rattlespace in the payload bay.

## IUS/Payload Support MMSE Data Sheets

1. IDENTIFICATION NO. 330-03-08-02-05
2. NAME Payload Mounting Beam (XPMB-2)
3. DATE \_\_\_\_\_
4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☐                      AUTO W IUS ☒  
    AUTO W TUG ☐                      CREW RELATED ☐                      OTHER ☐

5. JUSTIFICATION

Requirement:            Interface individually-mounted payloads with the IUS, or  
                                  with other standardized interfacing equipment (MMSE).

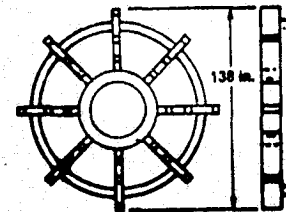
6. APPLICATION

POTENTIAL USERS Flights which include individually-mounted payloads  
(e.g., DSCS-II, FSC, DSP, or GPS) or multiple payloads on IUS involving these  
same payloads.

7. ALTERNATIVE SOLUTION IF NOT MMSE Equivalent item could be supplied by  
the payloads, or by the IUS program.

8. EQUIPMENT DESCRIPTION

- Supports individually mounted payloads using PIA-1, -2, or -3, or the interface adapter incorporated in the payload design.
- Mounts one set of SLP-1 assemblies at any of three diameters and one PSP-1 assembly.
- Conventional aluminum construction.
- Weight = 249 lb.
- Mounts directly on IUS interface, or on any XPLS (tandem payloads)



9. REMARKS IUS - 120 inch diameter interface with 8 unevenly spaced hard points.
10. RATIONALE FOR APPLICATION: The Payload Mounting Beam (XPMB-2) is used  
to support the payload directly (Martin recommended approach) on the Payload Inter-  
face Adapter (PIA) which is permanently mounted to the payload, or the payload  
adapter incorporated in the payload design. The beam supports the Separation Latch  
and Pushoff Assembly (SLP-1) which is used to deploy the payload.

## IUS/Payload Support MMSE Data Sheet

1. IDENTIFICATION NO. 330-03-08-03-03
2. NAME Payload Spacer (PLS-4)
3. DATE \_\_\_\_\_
4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☐                      AUTO W IUS ☒  
    AUTO W TUG ☒                      CREW RELATED ☐                      OTHER ☐

### 5. JUSTIFICATION

Requirement:      The forward payload(s) of a tandem arrangement cannot be supported by the aft payload without modification. A structural spacer is required.

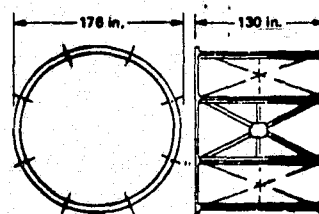
### 6. APPLICATION

POTENTIAL USERS      Some tandem mounted, multiple payloads, flights (e.g., two DSCS-II satellites or FSC and DSCS-II satellites) on IUS. Note: If recommended modification is made on XPLS-3, it would replace PLS-4 in these potential applications.

7. ALTERNATIVE SOLUTION IF NOT MMSE      (1) Spacer could be provided by payloads or by Tug or IUS program, (2) aft payload could carry the load of the forward payload.

### 8. EQUIPMENT DESCRIPTION

- PLS-4 is one of a family of 5 spacers of different lengths. Selection of length is flight configuration dependent.
- Both end frames incorporate Tug-type interfaces, i.e., 8 evenly spaced hard points. Aft frame mates with Tug or ITA-1, other frame used for attachment of PMB-1 or -2.
- Conventional aluminum construction.
- Weight = 272 lb.



### 9. REMARKS

10. RATIONALE FOR APPLICATION:      DSCS-II diameter = 108 inches. Martin states that 106 inches is the maximum diameter satellite that can be carried by the XPLS-3 (120 inch diameter). Therefore, the 176 inch diameter PLS-4 must be used.

## IUS/Payload Support MMSE Data Sheet

1. IDENTIFICATION NO. 330-03-08-03-05

2. NAME Payload Spacer (PLS-6)

3. DATE \_\_\_\_\_

4. CATEGORY:

SORTIE ☐  
AUTO W TUG ☐

AUTOMATED ☐  
CREW RELATED ☐

AUTO W IUS ☒  
OTHER ☒

### 5. JUSTIFICATION

Requirement: The forward payload(s) of a tandem arrangement cannot be supported by the aft payload. A structural spacer is required.

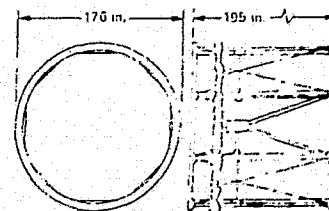
### 6. APPLICATION

POTENTIAL USERS Some tandem mounted multiple payload flights (e.g., two FSC satellites) on IUS. Note: If recommended modification is made on XPLS-3, it would replace PLS-4 in these potential applications.

7. ALTERNATIVE SOLUTION IF NOT MMSE (1) Spacer could be provided by payloads or by Tug program; (2) Aft payload could carry the load of the forward payload.

### 8. EQUIPMENT DESCRIPTION

- PLS-6 is one of a family of 5 spacers of different length. Selection of length is flight configuration dependent.
- Both end frames incorporate Tug-type interfaces; i.e., 8 evenly spaced hard points. Aft frame mates with Tug or ITA-1, other frame used for attachment of PMB-1 or -2.
- Conventional aluminum construction
- Weight = 358 lb.



### 9. REMARKS

10. RATIONALE FOR APPLICATION: The FSC is 192 inches long with a diameter of 105 inches. The diameter is under the XPLS limit (106") but no XPLS spacers are available which are more than 170 inches long. Therefore the PLS-6 must be used.

## IUS/Payload Support MMSE Data Sheet

1. IDENTIFICATION NO. 330-03-08-03-06
2. NAME Payload Spacer (XPLS-2)
3. DATE \_\_\_\_\_
4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☐                      AUTO W IUS ☒  
    AUTO W TUG ☐                      CREW RELATED ☐                      OTHER ☐

### 5. JUSTIFICATION

Requirement:      The forward payload(s) of a tandem arrangement cannot be supported by the aft payload. Also, payloads with kick stages cannot be supported on the baseline kick stage. A structural spacer is required.

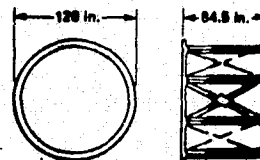
### 6. APPLICATION

POTENTIAL USERS All flights of payloads with kick stages and some tandem mounted flights - GPS

7. ALTERNATIVE SOLUTION IF NOT MMSE (1) Spacer could be provided by payloads or by IUS program, (2) aft payload could carry the loads of the forward payload.

### 8. EQUIPMENT DESCRIPTION

- XPLS-2 is one of a family of 3 spacers. Payloads with kick stages require XPLS-2. Selection of length is flight configuration dependent for tandem arrangements.
- Both end frames incorporate IUS-type interfaces, i.e., 8 unevenly spaced hard points. Aft frame mates with IUS, other frame used for attachment of XPMB-1, 2, or 3.
- Conventional aluminum construction.
- Weight = 112 lb.



### 9. REMARKS

10. RATIONALE FOR APPLICATION: The "Payload Spacer" (XPLS-2) is used to carry the load of the forward payload around the aft payload to the IUS.

## IUS/Payload Support MMSE Data Sheet

1. IDENTIFICATION NO. 330-03-08-03-07
2. NAME Payload Spacer (XPLS-3)
3. DATE \_\_\_\_\_
4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☐                      AUTO W IUS ☒  
    AUTO W TUG ☐                      CREW RELATED ☐                      OTHER ☐

### 5. JUSTIFICATION

Requirement:      The forward payload(s) of a tandem arrangement cannot be supported by the aft payload. A structural spacer is required.

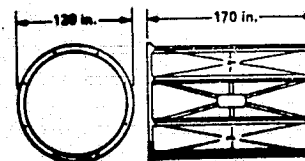
### 6. APPLICATION

POTENTIAL USERS      Multiple payloads (e.g., two DSCS-II satellites, or DSP and DSCS-II, or two FSC satellites, or FSC and DSCS-II satellites) but only if XPLS-3 is modified (see item 10 on this sheet).

7. ALTERNATIVE SOLUTION IF NOT MMSE      (1) Spacer could be provided by payloads or by IUS program, (2) aft payload could carry the load of the forward payload.

### 8. EQUIPMENT DESCRIPTION

- XPLS-3 is one of a family of 3 spacers. Same length as XPLS-4, but used with light payloads.
- Both end frames incorporate IUS-type interfaces, i.e., 8 unevenly spaced hard points. Aft frame mates with IUS, other frame used for attachment of XPMB-1 or -2.
- Conventional aluminum construction
- Weight - 200 lb.



9. REMARKS \_\_\_\_\_
10. MODIFICATIONS TO CONSIDER: Increase the diameter to approximately 125 inches, this would allow the FSC, the DSP, and the DSCS-II to be carried and have rattle space.
11. RATIONALE FOR APPLICATION: The Payload Spacer (XPLS-3) is used to carry the load of the forward payloads around the aft mounted payload to the IUS.

## IUS/Payload Support MMSE Data Sheet

1. IDENTIFICATION NO. 330-03-08-04
2. NAME Power Hinge and Latch Assembly (PHL-1)
3. DATE \_\_\_\_\_
4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☐                      AUTO W IUS ☒  
    AUTO W TUG ☒                      CREW RELATED ☐                      OTHER ☒

### 5. JUSTIFICATION

Requirement:      Release of the aft payload of a tandem arrangement requires moving the forward PMB out of the way. PHL-1 accomplishes this and allows return of MMSE on Tug flights not requiring payload retrieval. Forward MMSE is jettisoned on other flights.

### 6. APPLICATION

POTENTIAL USERS Tug flights with tandem mounted payloads, not involving retrieval of payloads. DSCS-II, FSC, DSP, GPS

7. ALTERNATIVE SOLUTION IF NOT MMSE Equivalent item could be supplied by payloads or by Tug program, or explosive bolts could be used.

### 8. EQUIPMENT DESCRIPTION

- Mounts on forward frame of PLSs.
- Rotates PMB-1 or -2 90° to allow release of aft payload, then latches PMB-1 or -2 back in place for return on Tug.
- Weight = 155 lb (Est.).

Configuration TBD

9. REMARKS Further study is required to determine if salvaging of MMSE by use of PHL-1 is cost effective.
10. RATIONALE FOR APPLICATION: The Power Hinge and Latch Assembly (PHL-1) is used to move the Payload Mounting Beams (which supported the forward payload) out of the way so that the aft payload can be deployed. In this analysis PHL-1 is not used; replaced with explosive bolts.



### IUS/Payload Support MMSE Data Sheet

1. IDENTIFICATION NO. 330-03-08-06
2. NAME Payload Docking Kit (PDK-1)
3. DATE 4 Sept. 1975
4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☐                      AUTO W IUS ☐  
    AUTO W TUG ☒                      CREW RELATED ☐                      OTHER ☐

5. JUSTIFICATION

Requirement: Tug must be equipped to dock, index, and remate interface plates with payloads which require retrieval.

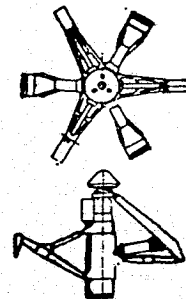
6. APPLICATION

POTENTIAL USERS FLTSATCOM, DSP, DSCS-II, GPS

7. ALTERNATIVE SOLUTION IF NOT MMSE Equivalent provided by Tug

8. EQUIPMENT DESCRIPTION

- Mounts only on PBM-2
- Includes TV camera and lights
- Incorporates radial clocking capability to align std payload interface (PIAs) with mating equipment (SLP-1 and PSP-1) mounted on PMB-2
- Interfaces with PDK-2 which is mounted on the payload attached PIAs
- Weight: 50 lb



9. REMARKS

10. MODIFICATIONS TO CONSIDER: Addition of a recovery control unit to distribute power and commands for C&W, S&A, telemetry, etc.

11. RATIONALE FOR APPLICATION (and Non-Application):

Contingency retrieval.

## IUS/Payload Support MMSE Data Sheet

1. IDENTIFICATION NO. 330-03-08-07

2. NAME Payload Docking Kit (PDK-2)

3. DATE 4 Sept. 1975

4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☐                      AUTO W IUS ☐  
    AUTO W TUG ☒                      CREW RELATED ☐                      OTHER ☐

5. JUSTIFICATION

Requirement: Payloads to be retrieved must provide a Tug compatible docking interface.

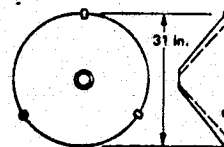
6. APPLICATION

POTENTIAL USERS FLTSATCOM, DSP, DSCS-II, GPS when flown on Tug.

7. ALTERNATIVE SOLUTION IF NOT MMSE Equivalent item provided by payload or Tug.

8. EQUIPMENT DESCRIPTION

- Mounts on PIA-1, 2, 3, 4
- Includes docking target
- Interfaces with PDK-1 which is mounted on Tug via PMB-2
- Incorporates mating feature to facilitate radian clocking of payload by PDK-1
- Weight: 23 lb
- Used with PSP-2 and SLP-1



9. REMARKS Tug - equipped with PDK-1, as companion equipment.

10. CLARIFICATION OF DESCRIPTION: Docking target is assumed to include laser reflectors for Tug acquisition and a passive indexing sensor for mating connectors and separation latch assembly (SLP-1).

11. RATIONALE FOR APPLICATION (and Non-Application): Contingency retrieval.

## IUS/Payload Support MMSE Data Sheet

1. IDENTIFICATION NO. 330-03-08-08-01

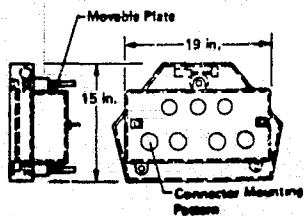
2. NAME Payload Services Plate (PSP-1)

3. DATE \_\_\_\_\_

4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☒                      AUTO W IUS ☒  
    AUTO W TUG ☒                      CREW RELATED ☐                      OTHER ☐

5. JUSTIFICATION	Requirement: All payloads require disconnectable fluid and electrical service lines across their separation interfaces; many require reconnection of these lines for payload retrieval.
6. APPLICATION	POTENTIAL USERS <u>All IUS flights, all upper stage payloads = DSCS-II, FSC, DSP, GPS, etc. plus LEO<sup>(1)</sup>.</u>

7. ALTERNATIVE SOLUTION IF NOT MMSE Equivalent item could be supplied by the payloads.

<p>8. EQUIPMENT DESCRIPTION</p> <ul style="list-style-type: none"> <li>• Mounts on PMB-1, -2, -3, XPMB-1, -2, -3 and on APS-1 and PUS-1.</li> <li>• Motorized movable plate is actuated to disconnect/reconnect the connectors.</li> <li>• Connectors mate with payload halves of connectors attached to PSP-2, which is mounted on the payload attached PIAs.</li> <li>• Weight = 13 lb.</li> </ul>	
--	---

9. REMARKS Reference states that connector details are TBD.

10. CLARIFICATION OF DESCRIPTION: When PSP-1 is defined as standard payload interfacing equipment (see 9 above), the connector capacity should include DoD requirements

(1) Any Low Earth Orbit (LEO) DoD payload which would mount on APS-1.

## IUS/Payload Support MMSE Data Sheet

### Payload Services Plate (PSP-1), 330-03-08-08-01 (Cont'd)

#### 11. RATIONALE FOR APPLICATION

The payload services plate (PSP-1) is mounted on the mounting beam and connects with the payload services plate (PSP-2) which is mounted on the payload. All disconnectable fluid and electrical lines are mated at this joint.

## IUS/Payload Support MMSE Data Sheet

1. IDENTIFICATION NO. 330-03-08-08-02
2. NAME Payload Services Plate (PSP-2)
3. DATE \_\_\_\_\_
4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☒                      AUTO W IUS ☒  
    AUTO W TUG ☒                      CREW RELATED ☐                      OTHER ☐

5. JUSTIFICATION

Requirement:      All payloads require disconnectable fluid and electrical service lines across their separation interfaces; many require reconnection of these lines for payload retrieval.

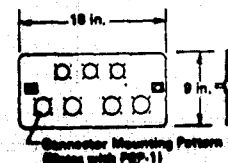
6. APPLICATION

POTENTIAL USERS      All upper stage payloads = DSCS-II, FSC, DSP, GSP, etc.  
                                  plus LEO<sup>(1)</sup>.

7. ALTERNATIVE SOLUTION IF NOT MMSE      Equivalent item must be supplied by  
    the payloads.

8. EQUIPMENT DESCRIPTION

- Mounts on PIA-1, -2, -3, -4, -5, and XPIA-1, or the interface adapter incorporated in the payload design.
- Mounts directly to the 17 large automated payloads which are direct mounted in the orbiter payload bay.
- Connector halves mate with those attached to PSP-1, which is mounted on MMSE.
- PSP-2 "floats" slightly to facilitate alignment with connectors on PSP-1.
- Weight = 7 lb.



9. REMARKS      Reference      states that connector details are TBD.
10. CLARIFICATION OF DESCRIPTION:      When PSP-2 is defined as standard payload  
    interfacing equipment (see "Remarks" above), the connector capability must include  
    DoD requirements.

(1) Any Low Earth Orbit (LEO) DoD payload which would mount on APS-1.

## IUS/ Payload Support MMSE Data Sheet

### Payload Services Plate (PSP-2), 330-03-08-08-02 (Cont'd)

#### 11. RATIONALE FOR APPLICATION

The payload services plate (PSP-2) is mounted on the payload and connects with the payload services plate (PSP-1) which is mounted on the mounting beam. All disconnectable fluid and electrical lines are mated at this joint.

## IUS/Payload Support MMSE Data Sheet

1. IDENTIFICATION NO. 330-03-08-09
2. NAME IUS/Tug Adapter (ITA-1)
3. DATE \_\_\_\_\_
4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☐                      AUTO W IUS ☒  
    AUTO W TUG ☒                      CREW RELATED ☐                      OTHER ☐

5. JUSTIFICATION

Requirement:      No firm requirement exists at this time. However, the ITA provides a Tug-type interface on the IUS for accommodating large diameter payloads requiring Tug-type MMSE (PMBs and PLSs).

---

6. APPLICATION

POTENTIAL USERS      On tandem mounted multiple payload IUS flights with large payloads (greater than 106 inch diameter) when payload spacer PLS-4 is used (e. g., DSCS-II/FSC or two DSCS-II satellites)

---

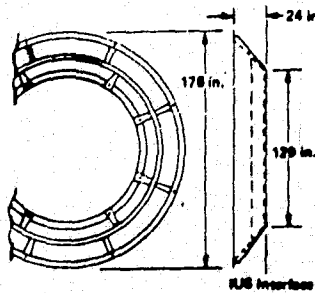


---



---

7. ALTERNATIVE SOLUTION IF NOT MMSE      Equivalent item could be supplied by the using payloads, or by the IUS program,
- 

<p>8. EQUIPMENT DESCRIPTION</p> <ul style="list-style-type: none"> <li>Conventional aluminum construction.</li> <li>The 120 inch diameter interfaces with the IUS, while the 176 inch diameter incorporates 8 evenly spaced hard points for mounting the PMBs or PLSs.</li> <li>Weight = 243 lb.</li> </ul>	
---	---

9. REMARKS      IUS - 120 inch diameter interface with 8 unevenly spaced hard points.
- 
10. RATIONALE FOR APPLICATION:      The IUS/Tug adapter must be used when the 176 inch diameter spacers are used on the 120 inch diameter IUS.
-

## IUS/Payload Support MMSE Data Sheet

1. IDENTIFICATION NO. 330-03-08-10
2. NAME Separation Latch and Push-Off Assembly (SLP-1)
3. DATE \_\_\_\_\_
4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☒                      AUTO W IUS ☒  
    AUTO W TUG ☒                      CREW RELATED ☐                      OTHER ☐

### 5. JUSTIFICATION

Requirement:      Structural latching, release, separation, and relatching of payloads to carriers; used in conjunction with standardized interfacing equipment (MMSE).

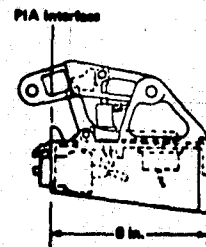
### 6. APPLICATION

POTENTIAL USERS All IUS flights, all upper stage payloads = DSCS-II, FSC, DSP, GPS, etc. plus LEO<sup>(1)</sup>

7. ALTERNATIVE SOLUTION IF NOT MMSE Equivalent item could be supplied by the payloads.

### 8. EQUIPMENT DESCRIPTION

- Payload latching, release, separation, and relatching operations are pneumatically (N<sub>2</sub>) powered, electrically controlled.
- Sets of 8 SLP-1 assemblies are mounted at appropriate diameter on the PMBs to interface with the PIAs or the interface adapter incorporated in the payload design.
- Weight - 63 lb (set of 8).
- Conventional aluminum and steel construction.
- Payload separation velocity can be controlled or deactivated (for automated payloads). Operation assures low tip-off rates.



### 9. REMARKS

10. RATIONALE FOR APPLICATION: These separation latch and push-off assemblies are needed whenever the MMSE payload mounting beams (PMB) are used, in order to release the payload at deployment.

(1) Any Low Earth Orbit (LEO) DoD payload which would mount on APS-1.



## Orbiter Payload Support MMSE Data Sheet

1. IDENTIFICATION NO. 330-03-06-02

2. NAME Payload Shroud

3. DATE \_\_\_\_\_

4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☐                      AUTO W IUS ☒  
    AUTO W TUG ☒                      CREW RELATED ☐                      OTHER ☐

### 5. JUSTIFICATION

Requirement:      Payloads specify maximum acoustic environment 135 kB OASPL. Attenuation at high frequencies provided by shroud. Protect payload from reentry contamination. Orbiter payload bay acoustic environment is predicted to be 145 dB OASPL.

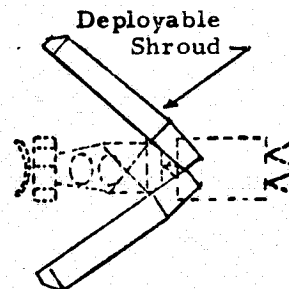
### 6. APPLICATION

POTENTIAL USERS DSP (DMSP, SOSS for orbiter mounted shroud)

7. ALTERNATIVE SOLUTION IF NOT MMSE See "Remarks," Item 9, of this Data Sheet.

### 8. EQUIPMENT DESCRIPTION

- Payload shroud covers entire payload.
- Dimension 13 ft dia x 25 ft length.
- Weight = 1850 lb.
- Density = 2#/ft<sup>2</sup> (10 dB attenuation).
- Deployment - expendable.
- Special Provisions - access door and coolant loop connections for RTG cooling requirement.



9. REMARKS Preferred approach is (1) reduce orbiter OASPL or improve payload tolerance, or (2) provide dust cover over individual critical unit.

10. CLARIFICATION OF DESCRIPTION: Volume = 4900 ft<sup>3</sup>; c.g. is TBD.

## Orbiter Payload Support MMSE Data Sheet

### Payload Shroud, 330-03-06-02 (Cont'd)

#### 11. MODIFICATIONS TO CONSIDER:

- Provide modularization segments for varying shroud length to improve versatility of shroud use.
- Operational issues which should be addressed:
  - a. Operating sequence of events for returning payload resulting from abort.
  - b. Pressurization system considerations.
  - c. Impact of RTG cooling unit and lines and MMSE electrical cabling.
  - d. Reuse of shroud.
  - e. Telemetry system for interrogating payload prior to deployment.
- Difficult to attach shroud if payload does not use IUS. Recommend that a design which attaches to payload be investigated so that shroud can be used without IUS. Simplifies access to payload with MMSG electrical cables and fluid lines.

#### 12. RATIONALE FOR APPLICATION:

- Every attempt should be made to protect individual critical unit.
- Attempt to successfully protect payload with shroud from orbiter bay acoustic environment is questionable because the high sound pressure level occurs at lower frequency.
- Although there are no requirements on current spacecraft design, shroud may be required for backup to potential problem areas.
  - Protection from contaminants from other (flight sharing) payloads
  - Protect payload from reentry debris during abort, provides quick turnaround time to payload mission
  - Protect payload from orbiter RCS plumes and orbiter exhausted expendables
- MDAC recommends expendable shroud for DMSP and local protection for SOSS.

## Orbiter Payload Support MMSE Data Sheet

1. IDENTIFICATION NO. 330-03-09-01

2. NAME Payload Umbilical Support (PUS-1)

3. DATE 25 September 1975

4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☒                      AUTO W IUS ☐  
    AUTO W TUG ☐                      CREW RELATED ☐                      OTHER ☐

### 5. JUSTIFICATION

Requirement:      Large, direct-mounted automated payloads require support for the disconnectable/reconnectable fluid and electrical service connectors, and associated lines and bundles.

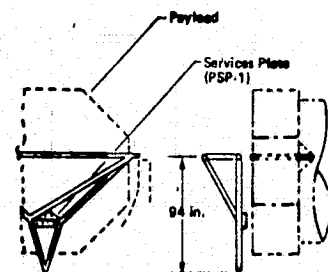
### 6. APPLICATION

POTENTIAL USERS      There is no apparent application of this item for the DoD spacecraft covered by this study.

7. ALTERNATIVE SOLUTION IF NOT MMSE      See Remarks

### 8. EQUIPMENT DESCRIPTION

- Supported at Shuttle payload bay hard points.
- Conventional aluminum tube construction
- Weight = 100 lb.



9. REMARKS      Preliminary design studies indicate the optimum solution for both the Shuttle deployed and IUS deployed spacecraft is pallet or cradle mounted umbilicals.  
Shuttle Capability - Provides only a standard pattern of attachment points.

## Orbiter Payload Support MMSE Data Sheet

1. IDENTIFICATION NO. 330-03-09-02
2. NAME Automated Payload Support (APS-1)
3. DATE \_\_\_\_\_
4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☒                      AUTO W IUS ☐  
    AUTO W TUG ☐                      CREW RELATED ☐                      OTHER ☐

### 5. JUSTIFICATION

Requirement: Automated payloads which are not suitable for direct mounting must be supported in the orbiter payload bay

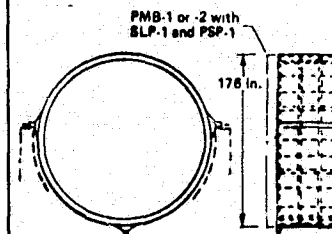
### 6. APPLICATION

POTENTIAL USERS Short payloads which would not encounter dynamic loading problems resulting from cantilevered mount, DMSP

### 7. ALTERNATIVE SOLUTION IF NOT MMSE

### 8. EQUIPMENT DESCRIPTION

- Supported at orbiter payload bay hard points.
- Mounts PMB-1 or -2 with SLP-1 and PSP-1 for use with most payloads. Two payloads must supply special support trusses which attach to APS-1.
- Conventional aluminum construction
- Weight - 525 lb
- May be used to mount payload support equipment such as power regulators, etc.



9. REMARKS Orbiter - provides standard pattern of hard points at 94 in radius, for attachment of payloads within the payload bay.

ORIGINAL PAGE IS  
OF POOR QUALITY

## Orbiter Payload Support MMSE Data Sheet

### Automated Payload Support (APS-1), 330-03-09-02 (Cont'd)

#### 10. RATIONALE FOR APPLICATION

The method of mounting payloads on the APL-1 is by cantilevering them from an adapter (PMB-1 or -2) which is in turn attached to the APS-1. Current IUS studies of payloads cantilevered from the IUS mounted in the cargo bay have shown that high transverse loading conditions in the payload result during ascent and landing with a cantileverer mount arrangement. The APS-1 is not considered to be a suitable means of payload support for payloads which would encounter high dynamic loads as a result of cantilever mounting. In these cases, the payload should be mounted on a cradle such as UPC-1. Shorter, stiffer payloads could make use of the APS-1.

Neither of the two Low Earth Orbit (LEO) DoD spacecraft under consideration for this study are candidates for use with the APS-1. The DMSP can be mounted on the GPP-1. The combined length of the SOSS, APS-1, and PMB-2 is 59 feet. The cargo bay, with the OMS kit installed, cannot accommodate the 59-foot length. While the GPP has been identified for use with the DMSP, the APS-1 or the UPC could also be considered as candidate support structures for the DMSP.

## Orbiter Payload Support MMSE Data Sheet

1. IDENTIFICATION NO. 330-03-09-03
2. NAME Tilt Table (TT-1)
3. DATE \_\_\_\_\_
4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☒                      AUTO W IUS ☐  
    AUTO W TUG ☐                      CREW RELATED ☐                      OTHER ☐

5. JUSTIFICATION

Payloads which are mounted in UPC-1, -2, or APS-1 may not accept the RMS and Payload Installation Aid as a means of deployment and could require a tilt table. Potential plume impingement problems could possibly be avoided by use of a tilt table which would position the payload away from the forward portion of the orbiter.

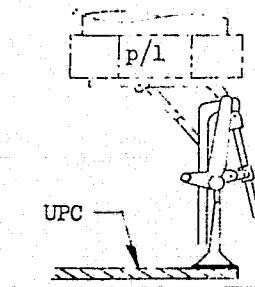
6. APPLICATION

POTENTIAL USERS Any payload which could not use the RMS and Payload Installation Aid. No DoD users identified.

7. ALTERNATIVE SOLUTION IF NOT MMSE \_\_\_\_\_

8. EQUIPMENT DESCRIPTION

- Mounts directly to aft end of UPC-1, -2, or to orbiter payload bay hard points.
- Used during deployment or retrieval operations on orbit.
- Weight - 950 lb.



9. REMARKS \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

## Orbiter Payload Support MMSE Data Sheet

### Tilt Table (TT-1), 330-03-09-03 (Cont'd)

#### 10. CLARIFICATION OF DESCRIPTION

With the use of UPC-1, -2, the payload is mounted to the TT-1 as well as to the UPC. Therefore, structural loads are carried by both UPC and TT-1. With the use of APS, the TT-1 is the only support for the payload.

#### 11. MODIFICATIONS TO CONSIDER

Perhaps two versions of TT-1 should be developed. The first, lighter weight version for use with UPC, and the second, heavier version for use with APS.

#### 12. RATIONALE FOR APPLICATION

There could exist payloads in the DoD model which are not adaptable to the RMS plus payload installation aid. For these applications, a tilt table could offer an alternative.

## Orbiter Payload Support MMSE Data Sheet

1. IDENTIFICATION NO. 330-03-10-01-06

2. NAME General Purpose Platform (GPP-2)

3. DATE 14 September 1975

4. CATEGORY:                      SORTIE ☒                      AUTOMATED ☒                      AUTO W IUS ☐  
    AUTO W TUG ☐                      CREW RELATED ☐                      OTHER ☐

### 5. JUSTIFICATION

Requirement - Carry-on payloads, payload elements with special viewing constraints, and payloads with inadequate pallet space (pallet overflow) can benefit from utilizing space forward of the Spacelab module, above the tunnel.

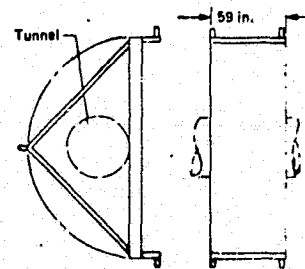
### 6. APPLICATION

POTENTIAL USERS DMSP, RTC

7. ALTERNATIVE SOLUTION IF NOT MMSE Equivalent item could be provided by Spacelab program, by the payloads, or by the orbiter program.

### 8. EQUIPMENT DESCRIPTION

- Supported at orbiter payload bay hard points.
- Provides versatile mounting pattern for attachment of components and assemblies.
- Fits above Spacelab tunnel.
- Conventional aluminum construction.
- Weight - 425 lb.
- Length can be extended by use of up to 3 platforms.



9. REMARKS Orbiter - provides hard points for attachment.



## Orbiter Payload Support MMSE Data Sheet

### General Purpose Platform (GPP-2), 330-03-10-01-06 (Cont'd)

#### 10. CLARIFICATION OF DESCRIPTION

For use with the DMSP, three platforms will be required (length = 168 inches) to accommodate the 156-inch long DMSP. Deployment from the cargo bay can be accomplished with the RMS in conjunction with the payload installation aid (Reference NASA JSC Briefing Charts, 23 January 1975) and the RMS.

#### 11. MODIFICATION TO CONSIDER

Each payload will require unique support structure to tie it to the GPP. In addition, separation mechanisms will be required to release the payload for deployment.

#### 12. RATIONALE FOR APPLICATION

Smaller spacecraft such as the DMSP can find more launch opportunities as a secondary payload to such programs as Spacelab. Another DoD program which is considering secondary payload applications is the Space Test Program (STP). STP is presently studying a standard STP satellite which would ride either over the Spacelab tunnel or in a clear 15-foot diameter bay area forward of a primary payload. For the Spacelab use, the GPP would be required. When the RTG is required and there is no IUS cradle for mounting, the GPP could be used.

## Orbiter Payload Support MMSE Data Sheet

1. IDENTIFICATION NO. None
2. NAME Center of Gravity Ballast Kit
3. DATE 9/2/75
4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☒                      AUTO W IUS ☐  
   AUTO W TUG ☐                      CREW RELATED ☐                      OTHER ☐

5. JUSTIFICATION

Requirement - Automated payloads with adverse weight concentration and limited amount of fore-aft location option which violate the c.g. envelope require ballast.

6. APPLICATION

POTENTIAL USERS SOSS, Single DMSP (attached to OMS kit)  
DSP/IUS (Transtage example)

7. ALTERNATIVE SOLUTION IF NOT MMSE Payload-unique Ballast Kits, Orbiter supplied bridges.

8. EQUIPMENT DESCRIPTION

Ballast kit consists of increments of weight which can be used to vary total weight from a few hundred to a few thousand pounds. These units utilize standard payload attach locations in the forward end of the orbiter payload bay.

9. REMARKS

## Orbiter Payload Support MMSE Data Sheet

### Center of Gravity Ballast Kit (Cont'd)

#### 10. CLARIFICATION OF DESCRIPTION

Those payloads which have adverse weight concentration (aft) and have limited fore-aft location option because of length and cannot be multiplied with other payloads (length), require forward ballast to meet the c.g. envelope constraints. OMS kit requirements increase the problem. The problem may be solved with smaller length payloads by moving the location forward or multiplying with other payloads.

#### 11. RATIONALE FOR APPLICATION

SOSS is 53 feet long which, with the OMS kit, allows only about 20 inches of flexibility in mounting location; c.g. is aft of the allowable envelope. Approximately 500 pounds at Sta. 611,622 bulkhead are required. An alternative is to invert the SOSS. A single DMSP requires approximately 250 pounds of ballast at Sta. 611.

## Orbiter Payload Support MMSE Data Sheet

1. IDENTIFICATION NO. NONE
2. NAME RMS End Effector Umbilical Connector
3. DATE \_\_\_\_\_
4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☒                      AUTO W IUS ☐  
   AUTO W TUG ☐                      CREW RELATED ☐                      OTHER ☐

5. JUSTIFICATION

Requirement: Orbiter must be equipped to retrieve payloads deployed by the RMS on a contingency basis.

6. APPLICATION

POTENTIAL USERS DMSP, SSOS

7. ALTERNATIVE SOLUTION IF NOT MMSE Item provided by orbiter.

8. EQUIPMENT DESCRIPTION

- Includes capability to reconnect power and fluid interfaces for C&W, S&A, telemetry command
- Fluid interface - IMU N<sub>2</sub> purge

9. REMARKS Alternative is a separate umbilical connect scheme (EVA)

10. CLARIFICATION OF DESCRIPTION: Remote umbilical connect/disconnect is included as well as structural attachment.
11. RATIONALE FOR APPLICATION (and Non-Application): Contingency retrieval of orbiter deployed payloads requires umbilical reconnect to provide power for command, C&W, S&A, telemetry and, in some cases, fluid interface reconnect.

Reference: SAMSO-TR-75-136, p. 40, 46

## Orbiter Payload Support MMSE Data Sheet

1. IDENTIFICATION NO. None
2. NAME Universal Payload Cradle (UPC-1, -2)
3. DATE \_\_\_\_\_
4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☒                      AUTO W IUS ☐  
    AUTO W TUG ☐                      CREW RELATED ☐                      OTHER ☐

5. JUSTIFICATION

Automated payloads which are not suitable for direct mounting must be supported in the orbiter payload bay.

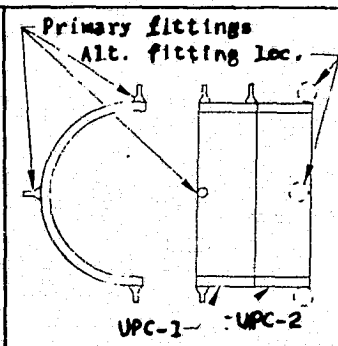
6. APPLICATION

POTENTIAL USERS SOSS and other DoD payloads not using IUS, GPP, or APS.

7. ALTERNATIVE SOLUTION IF NOT MMSE Payloads must provide own means of attachment to orbiter bay.

8. EQUIPMENT DESCRIPTION

- Basic cradle (UPC-1) has 3 primary attach fittings plus one stabilizing fitting.
- Alternate fitting locations are provided on 59 in centers.
- Payload attach to cradle requires payload-unique fittings.
- Add on sections (UPL-2) 59 in long extend cradle length up to full 60 ft cargo bay length.
- Weight 600 lb per section.



9. REMARKS \_\_\_\_\_

## Orbiter Payload Support MMSE Data Sheet

### Universal Payload Cradle (UPC-1, -2) (Cont'd)

#### 10. CLARIFICATION OF DESCRIPTION

The basic cradle (UPC-1) is 65 inches long and can be mounted to the orbiter via the four fittings provided. For extended length, additional sections (UPC-2) can be bolted to UPC-1. The sections (UPC-2) cannot be attached to the cargo bay without the use of the basic cradle. Attachment of the payload to the cradle requires additional structure which would be unique to the payload. This additional structure becomes part of the cradle. It also provides the release devices necessary to allow deployment of the payload.

Actual payload deployment is accomplished through the use of the payload installation aid (Reference NASA JSC Briefing Charts, 23 January 1975) and the RMS. The concept is similar to the segmented pallet presented in the Sortie Lab Users' Guide, MSFC, April 1973.

#### 11. MODIFICATIONS TO CONSIDER

As stated in Item 10 above, each payload will require unique attach structure and separation devices. These could be considered modifications to the cradle.

#### 12. RATIONALE FOR APPLICATION

Payloads will have to be supported at intervals along their length in the orbiter bay during launch and landing in order to help alleviate high dynamic loading conditions. In addition, fluid

## Orbiter Payload Support MMSE Data Sheet

### Universal Payload Cradle (UPC-1, -2) (Cont'd)

#### RATIONALE FOR APPLICATION (Cont'd)

and electrical services may have to be provided at various locations along the payload. A cradle will provide a support for these service lines.

#### 13. ADDITIONAL INFORMATION

As a result of trying to use the APS-1 with PIA-3, PMB-2, and SLP-1 to support the 112-inch diameter by 53-feet long SOSS while leaving space for the OMS kit, a length interference was discovered. Also, cantilever support of such a long, heavy payload from the APS-1 is questionable due to the dynamic excursions and possible high loads which could be incurred. Therefore, a method of supporting long payloads by using a Universal Payload Cradle is recommended as added MMSE.

The cradle is fabricated in segments with attach fittings spaced 59 inches on center to mate with the orbiter payload bay attach points. Two segments are used: (1) the basic segment is approximately 64 inches long and has three primary fittings plus provision for a fourth stabilizing fitting, and (2) additional segments are 59 inches long and contain provisions for a fourth stabilizing fitting which would replace the stabilizing fitting on the basic segment. Either the basic cradle segment can be used alone to support a payload or additional length can be gained by bolting additional segments onto the basic segment.

## Orbiter Payload Support MMSE Data Sheet

### Universal Payload Cradle (UPC-1, -2) (Cont'd)

#### ADDITIONAL INFORMATION (Cont'd)

The Universal Payload Cradle is fashioned after the special pallets used for sortie missions. Such a cradle might also be used to support the IUS in the payload bay.

A survey of large NASA payloads such as LST and other orbiting observatories should be made to assess the need for a cradle of this type to determine the inner diameter(s) and the details of payload support in the cradle.



## Orbiter Payload Support MMSE Data Sheet

1. IDENTIFICATION NO. None

2. NAME Tilt Table (TT-2)

3. DATE \_\_\_\_\_

4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☒                      AUTO W IUS ☐  
    AUTO W TUG ☐                      CREW RELATED ☐                      OTHER ☐

5. JUSTIFICATION

Same as for TT-1, except used with GPP only.

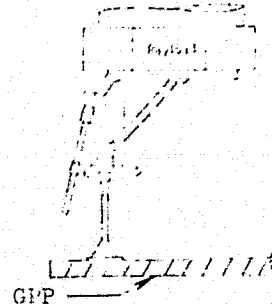
6. APPLICATION

POTENTIAL USERS Any payload which could not use the RMS and Payload  
Installation Aid. No DoD users identified.

7. ALTERNATIVE SOLUTION IF NOT MMSE \_\_\_\_\_

8. EQUIPMENT DESCRIPTION

- Smaller version of TT-1.
- Mounts directly to GPP.



9. REMARKS \_\_\_\_\_

10. CLARIFICATION OF DESCRIPTION TT-2 is intended only for use with GPP. It is  
rigidly attached to both the payload and GPP.

11. RATIONALE FOR APPLICATION Same as TT-1

## 5.4 RTG COOLING

### 5.4.1 Introduction

Reference 1 contains five data sheets (pages 99-103) that describe a proposed unit to be mounted in the payload bay of the orbiter to provide the required cooling for payloads equipped with RTGs. The data sheets were reviewed to determine compatibility of the unit with DoD payloads.

The unit as described consists of a water circulant/water evaporant system. Water in a closed loop circulates through the coolant jackets encapsulating the RTGs and is in turn cooled by passing (1) through a GSE heat exchanger during ground operations prior to launch, and (2) through a supplementary heat exchanger which uses stored water for flash evaporation during all other phases of the mission.

### 5.4.2 MMSE and Orbiter Characteristics

The DoD payload with the maximum heat generation is the LES 8-9-9 with 6 RTGs (each LES satellite has 2 RTGs). Each RTG generates 2400 watts or 8200 Btu/hr so that the total heat rejection rate is 49.2 K Btu/hr. For a 15 hour mission, the total heat rejected is 738 K Btu, and the maximum amount of stored water is 738 lb.

Total heat rejected is:

1. 58 K Btu minimum
2. 246 K Btu nominal
3. 738 K Btu maximum.

The orbiter heat rejection capability is as follows.

1. Doors closed (ascent and reentry): 5.2 K Btu/hr is provided by the orbiter flash evaporator above 100 K altitude and by the orbiter ammonia boiler below 100 K.
2. Doors open (on orbit): 21.5 K Btu/hr baseline heat rejection capability through the use of six radiator panels mounted on the doors. Two additional (payload chargeable) radiator panels can be mounted on the aft doors, increasing the capability to 29 K Btu/hr.

The sketch of the cooling system (under RTG Cooling Units Item 8, p. 99, Reference 1) does not show connections to a GSE heat exchanger even though one is called out under Item 23.

#### 5.4.3 Comments on the Selected System

The water/water system, as described in References 1 and 15, has several drawbacks.

1. The system does not take advantage of the capability of the orbiter radiator panels on orbit with doors open. A dual mode of operation (a) water boiler when doors are closed, (b) orbiter radiator when doors are open, could reduce the evaporant weight requirement considerably since, according to mission timelines, most of the RTG cooling takes place while the doors are open.
2. There is a possibility of payload contamination by the water vapor vented while the doors are open. The dual mode discussed above eliminates this problem for payloads rejecting heat at rates below the radiator capacity available for payload cooling.
3. Depending on the orientation of the orbiter, there is a possibility that the water lines will freeze, after RTG/payload deployment. If Freon is used as the closed-loop circulant, this problem is eliminated.

#### 5.4.4 Comments on the Need for an RTG Coolant Jacket

The ground rule for the Martin Marietta study was that an existing RTG should be used for this study. Since all current RTGs are air cooled, the need for a liquid coolant jacket is obvious. In a future study, however, it appears worthwhile to consider the possibility of redesigning the RTG to include an internal liquid coolant loop. The advantages of a redesigned RTG are:

1. Eliminates the need for an encapsulator, its mounting and actuator, and saves weight
2. Eliminates the need for a GSE heat exchanger since ground A/C can be used
3. Eliminates umbilical connection to GSE exchanger
4. Reduces pumping power and coolant requirements
5. Simplifies installation of RTG in orbiter bay
6. Simplifies payload deployment.

The disadvantages are:

1. Redesign of the RTG unit
2. Special A/C air ducting required for prelaunch cooling
3. Venting of the liquid in the RTG coolant loop after deployment
4. Disconnect coolant line prior to deployment
5. Reconnect coolant line after retrieval
6. Increase in spacecraft weight for upper stage operations.

#### 5.4.5 MMSE Data Sheet

The MMSE Data Sheet for the RTG Cooling Unit is presented on pages 5-55 and 5-56.

## RTG Cooling Unit MMSE Data Sheet

1. IDENTIFICATION NO. 330-03-06-01
2. NAME RTG Cooling Unit
3. DATE 2 Sept. 1975
4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☐                      AUTO W IUS ☒  
    AUTO W TUG ☒                      CREW RELATED ☐                      OTHER ☐

### 5. JUSTIFICATION

Requirement - Automated payloads with RTG's generate excess heat which must be removed and rejected. Rejected heat = 3 KBTU/hr (min) - 49 KBTU/hr (max).  
 Carrier capability - Orbiter payload bay heat exchange accommodates:

- a - 5.2 KBTU/hr doors closed (ascent & reentry)
- b - 21.5 KBTU/hr doors open
- 29 KBTU/hr doors open with added radiator panels

### 6. APPLICATION

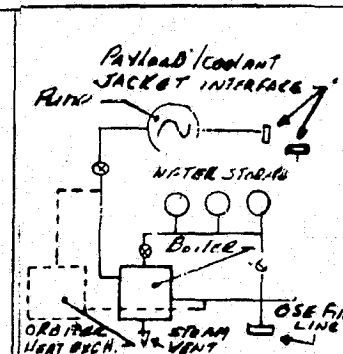
POTENTIAL USERS DOD LES 8-9, LES 8-9-9 (payloads with RTG units)

### 7. ALTERNATIVE SOLUTION IF NOT MMSE Payload unique RTG cooling unit.

### 8. EQUIPMENT DESCRIPTION

The RTG cooling unit consists of a pump, a supplementary heat exchange (boiler), storage tanks (water and interconnecting lines and control valves. During operation excess thermal energy is used to convert stored water to expendable steam. Storage tanks are manifolded to obtain desired heat rejection for specific mission and RTG configuration.

Unit Weight - 165 lb (min.) 1648 lb (max.)



9. REMARKS Significant cost savings result from standardization by eliminating redundant DDT&E effort for payload unique units.

RTG Cooling Unit MMSE Data Sheet  
(Continued)

10. CLARIFICATION OF DESCRIPTION:

- a. Encapsulation should be included in MMSE
- b. Ground-based heat exchanger (external to orbiter) needed for on-line prelaunch coding unless water boiler operates continuously on line
- c. Power supply and cooling unit control assembly needed
- d. Orbiter dump line for water boiler evaporant needed.

11. MODIFICATIONS TO CONSIDER:

- a. Freon closed-loop circulant/water evaporant (while doors closed)
- b. Freon loop passes through payload bay door radiator panels for door-open mode
- c. Delete encapsulator for a redesigned RTG to incorporate internal liquid coolant loop.

12. RATIONALE FOR APPLICATION:

Capacity meets DoD requirements.

## 5.5 ELECTRICAL/AVIONICS SUPPORT

### 5.5.1 Summary

MMSE item 01-02 is an auxiliary power unit consisting of silver zinc batteries and switching devices. The Shuttle power applied can be adequate for both the IUS and payloads. Spacecraft solar arrays without panels deployed are expected to be adequate during the IUS injection phase. The possibility that one or more of the spacecraft may need the auxiliary power unit as a backup power supply to the orbiter power needs to be studied. Unless this latter case develops, the auxiliary power unit does not appear to be required for DoD spacecraft.

The orbiter/payload service cabling and J-box (IUS deployed) MMSE item 05-03, provides interconnecting electrical conductors between the Shuttle service panels and junction box on or adjacent to the cradle supporting the IUS and IUS deployed spacecraft. The circuit capacity of about 80 wire pairs may be about right for the IUS or DSP spacecraft but may be too low for dual launches such as those planned for DSCS. It can also be applied to the DMSP and SOSS satellites. Therefore, it is recommended that the descriptor on this cabling unit drop the "IUS deployed" designation since the equipment can be applied to non-IUS payloads.

Payload umbilical cabling (IUS deployed), MMSE item 05-04, provides electrical conductors between the junction boxes for MMSE item 05-03 and the umbilical connectors. It is potentially applicable to the same DoD spacecraft.

The orbiter/payload service cabling and J-box, MMSE item 05-01, is not applicable to DoD spacecraft in its current configuration. With 195 wire pairs, it has excessive capacity and sacrifices too much

weight chargeable to the payload. However, it could be modified so that it would be applicable to DoD payloads sharing the orbiter payload bay. A lower capacity basic unit with a add-a-cable approach is recommended.

All DoD payloads require integration equipment to isolate or condition orbiter power for spacecraft usage. A description is included for an isolation power supply for consideration as a possible MMSE item.

DoD payloads will also require a safety control system for both the IUS and the spacecraft. A description of a unit described as "electrical conditioning and distribution assembly" is included and recommended for consideration as a possible MMSE item.

#### 5.5.2 MMSE Data Sheets

The MMSE Data Sheets pertaining to electrical/avionics support are presented on pages 5-59 through 5-66.



## Electrical/Avionics Support MMSE Data Sheet

1. IDENTIFICATION NO. 330-03-01-02

2. NAME Auxiliary Power Unit

3. DATE 25 September 1975

4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☐                      AUTO W IUS ☒  
    AUTO W TUG ☒                      CREW RELATED ☐                      OTHER ☐

### 5. JUSTIFICATION

Requirement:      For payloads which require power and energy in excess of that available from the Shuttle or the IUS before those needs can be supplied by the solar arrays.

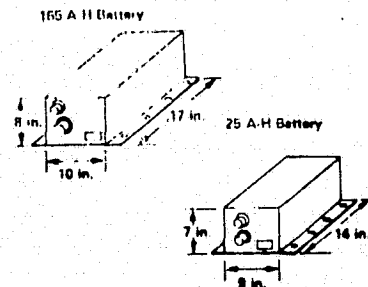
### 6. APPLICATION

POTENTIAL USERS This does not appear to be required for DoD spacecraft presently under consideration.

### 7. ALTERNATIVE SOLUTION IF NOT MMSE

### 8. EQUIPMENT DESCRIPTION

- Silver zinc batteries and switching devices
- Batteries weigh 81 and 36 lbs.
- Incorporated fault protection for the load.



9. REMARKS Shuttle power appears to be adequate for both the IUS and payloads.  
Preliminary calculations indicate that spacecraft solar arrays (without panels deployed)  
are adequate during the IUS injection phase.  
Capabilities - Shuttle: Not less than 1 kW average and 1.5 kW peak during worst case  
condition of ascent and descent. IUS: No power available for spacecraft.

## Electrical/Avionics Support MMSE Data Sheet

1. IDENTIFICATION NO. 330-03-05-01
2. NAME Orbiter/Payload Service Cabling and J-Box
3. DATE 25 September 1975
4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☒                      AUTO W IUS ☐  
    AUTO W TUG ☐                      CREW RELATED ☐                      OTHER ☐

### 5. JUSTIFICATION

Requirement:      Provide interconnecting electrical conductors between the Shuttle service panels and several distribution points in the payload bay such as on or adjacent to the pallet for Shuttle deployed spacecraft.

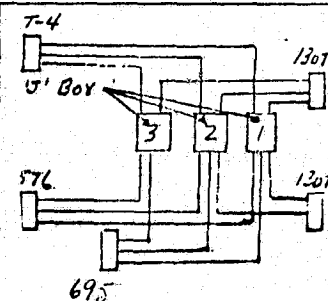
### 6. APPLICATION

POTENTIAL USERS      There is no apparent application of this item for DoD spacecraft covered by this study.

7. ALTERNATIVE SOLUTION IF NOT MMSE Payload peculiar cabling or the Orbiter/Payload Service Cabling and J-Box (IUS Deployed), MMSE 330-03-05-03.

### 8. EQUIPMENT DESCRIPTION

- Cable bundles terminated at connectors and junction boxes incorporate TP, TSP, TSQ, and coaxial conductors for C&W, C&C, power, and data functions.
- Provides for 16 coaxial conductors and A89 connector pins. If all pins were distributed between an equal no. of TP and TSP conductors, with each shield terminated at an individual pin, this would provide for a total of about 195 pairs.



9. REMARKS This far exceeds the interface requirements of the Shuttle deployed spacecraft now under consideration: DMSP and SOSS. They require less than a total of 30 pairs each of which two might be coaxial. For a dual launch, the maximum is about 60 pairs. Using this item would introduce a significant payload weight penalty.

## Electrical/Avionics Support MMSE Data Sheet

1. IDENTIFICATION NO. 330-03-05-02
2. NAME Payload Umbilical Cabling (Orbiter Deployed)
3. DATE 25 September 1975
4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☒                      AUTO W IUS ☐  
    AUTO W TUG ☐                      CREW RELATED ☐                      OTHER ☐

### 5. JUSTIFICATION

Requirement:      Provide interconnecting electrical conductors between junction boxes on or adjacent to the pallet, for Shuttle deployed spacecraft, and the umbilical connectors for those spacecraft. This item is used with the Orbiter/Payload Service Cabling and J-Box, MMSE 330-03-05-01.

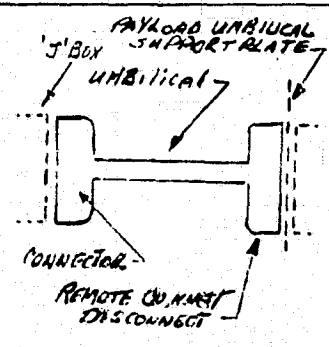
### 6. APPLICATION

POTENTIAL USERS      There is no apparent application of this item for DoD spacecraft covered by this study.

7. ALTERNATIVE SOLUTION IF NOT MMSE Payload peculiar cabling or the Payload Umbilical Cabling (IUS Deployed), MMSE 330-03-05-04.

### 8. EQUIPMENT DESCRIPTION

- Consists of one set of cables, each terminated by one or more connectors at one end and by a remotely controlled disconnect at the other.
- Other features are essentially identical to MMSE 330-03-05-01.



9. REMARKS Same as for MMSE 330-03-05-01.

## Electrical/Avionics Support MMSE Data Sheet

1. IDENTIFICATION NO. 330-03-05-03

2. NAME Orbiter/Payload Service Cabling and J-Box (IUS Deployed)

3. DATE 25 September 1975

4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☐                      AUTO W IUS ☒  
    AUTO W TUG ☐                      CREW RELATED ☐                      OTHER ☐

### 5. JUSTIFICATION

Requirement:      Provide interconnecting electrical conductors between the Shuttle service panels and several distribution points on or adjacent to the pallet supporting directly deployed spacecraft or the cradle supporting the IUS and IUS deployed spacecraft.

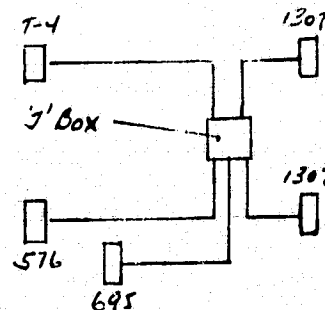
### 6. APPLICATION

POTENTIAL USERS DSCS-II, DSP, FSC, DMSP, SOSS

7. ALTERNATIVE SOLUTION IF NOT MMSE Payload peculiar cabling

### 8. EQUIPMENT DESCRIPTION

- Cable bundles terminated at connectors and junction boxes incorporate TP, TSP, TSQ, and coaxial conductors for C&W, C&C, power, and data functions.
- Provides for two coaxial conductors and approximately 200 connector pins. If all pins are distributed between an equal number of TP and TSP conductors, with each shield terminated at an individual pin, this would provide for a total of about 80 pairs.



9. REMARKS This circuit capacity may be about right for the IUS plus a DSP or FSC spacecraft, but may be too low for dual launches of DSCS. It is somewhat too high for a dual DMSP launch, and much greater than needed for SOSS. Continued refinement of the caution, warning, and safing requirements also may modify the required number of circuits quite significantly.

## Electrical/Avionics Support MMSE Data Sheet

1. IDENTIFICATION NO. 330-03-05-04
2. NAME Payload Umbilical Cabling (IUS Deployed)
3. DATE 25 September 1975
4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☐                      AUTO W IUS ☒  
    AUTO W TUG ☐                      CREW RELATED ☐                      OTHER ☐

5. JUSTIFICATION

Requirement:      Provide interconnecting electrical conductors between junction boxes on or adjacent to the pallet for Shuttle deployed spacecraft, or the cradle supporting the IUS plus spacecraft, and the umbilical connectors. Used with the Orbiter/Payload Service Cabling and J-Box (IUS Deployed), MMSE 330-03-05-03.

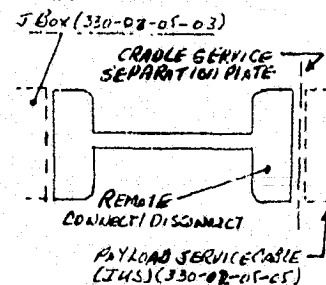
6. APPLICATION

POTENTIAL USERS DSCS-II, DSP, FSC, DMSP, SOSS

7. ALTERNATIVE SOLUTION IF NOT MMSE Payload peculiar cabling

8. EQUIPMENT DESCRIPTION

- Consists of one set of cables, each terminated by one or more connectors at one end and by a remotely controlled disconnect at the other.
- Other features are essentially identical to those of MMSE 330-03-05-03.



9. REMARKS Same as for MMSE 330-03-05-03.

## Electrical/Avionics Support MMSE Data Sheet

1. IDENTIFICATION NO. 330-03-05-05
2. NAME Payload Service Cable (IUS)
3. DATE 25 September 1975
4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☐                      AUTO W IUS ☒  
    AUTO W TUG ☐                      CREW RELATED ☐                      OTHER ☐

### 5. JUSTIFICATION

Requirement: Provides interconnecting electrical conductors between the Shuttle/IUS disconnect and the IUS/spacecraft disconnect. Used with the Orbiter/Payload Service Cabling and J-Box (IUS Deployed), MMSE 330-03-05-03, and the Payload Umbilical Cabling (IUS Deployed), MMSE 330-03-05-04.

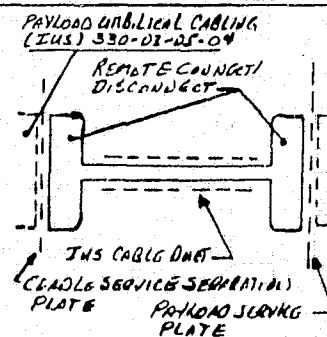
### 6. APPLICATION

POTENTIAL USERS There is no apparent application of this item for the DoD spacecraft covered by this study.

### 7. ALTERNATIVE SOLUTION IF NOT MMSE See Remarks

### 8. EQUIPMENT DESCRIPTION

- Consists of one or more cables terminated at each end in remotely controlled disconnect.
- Other features are essentially identical to MMSE 330-03-05-03 and MMSE 330-03-05-04.



9. REMARKS Preliminary design studies indicate the optimum solution embodies separate umbilicals for the IUS and spacecraft, both mounted on the cradle. With this arrangement, payload circuits do not pass through the IUS.
- IUS Capability - Supplies only cable ducts.

## Electrical/Avionics Support MMSE Data Sheet

1. IDENTIFICATION NO. TBD
2. NAME Isolation Power Supply
3. DATE 25 September 1975
4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☒                      AUTO W IUS ☒  
   AUTO W TUG ☐                      CREW RELATED ☐                      OTHER ☐

### 5. JUSTIFICATION

Requirement: DoD spacecraft commonly use battery boost voltage regulators with a threshold which is set at a value higher than the low limit of allowable Shuttle voltage. This condition produces discharge of spacecraft batteries. Spacecraft also have single-point grounds.

### 6. APPLICATION

POTENTIAL USERS DSCS-II, DSP, FSC, GPS, DMSP, SOSS

7. ALTERNATIVE SOLUTION IF NOT MMSE Incorporate an isolation power supply in the Shuttle power circuits to payloads.

### 8. EQUIPMENT DESCRIPTION

- Input Voltage - As defined by Shuttle voltage limits
- Output Voltage - Adjustable over range of 25 to 40 VDC
- Power Output - 500 W
- Weight - 75 lb.
- Control is from PSS/MSS area.

9. REMARKS Performance characteristics with respect to load induced ripple and transient response to load induced ripple are particularly important in this application.  
Shuttle Capabilities - Shuttle uses a multipoint ground.

~~PRECEDING PAGE BLANK NOT FILMED~~

## Electrical/Avionics Supply MMSE Data Sheet

1. IDENTIFICATION NO. TBD
2. NAME Electrical Conditioning and Distribution Assembly
3. DATE 25 September 1975
4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☒                      AUTO W IUS ☒  
   AUTO W TUG ☐                      CREW RELATED ☐                      OTHER ☐

### 5. JUSTIFICATION :

- Requirement:      Special safety provisions are required in the electrical circuits of payloads, both IUS and spacecraft, to control the application of power to any circuits which produce a hazardous condition for the Shuttle when they are energized. This includes thruster circuits, ordnance, latches securing the IUS/spacecraft to the cradle, and other similar functions.

### 6. APPLICATION

POTENTIAL USERS IUS, DSCS-II, DSP, FSC, DMSP, SOSS

7. ALTERNATIVE SOLUTION IF NOT MMSE Required features must be incorporated in the Shuttle/IUS/spacecraft.

### 8. EQUIPMENT DESCRIPTION

- Consists of a relay switching network for routing commands and resistor networks for isolating the corresponding bilevel monitor signals and scaling them to values suitable for the inputs to the Shuttle multiplexer-demultiplexer (MDM).
- Weight = 8 lbs.

9. REMARKS The name for this device is that which has been used in the existing reports, but it is not very descriptive of the actual function. A suitable name change is suggested.
- Shuttle/IUS/Spacecraft Capability - Incomplete from a rigorous Shuttle safety standpoint.



## 5.6 FLUID SUPPORT

### 5.6.1 Introduction

Reference 1 has been reviewed to determine if Shuttle equipment identified for use with NASA payloads is also usable with DoD payloads. Six DoD payloads were identified as models to determine the usability of the equipment cataloged in the reference. These payloads are:

DSCS-II	-	Defense Satellite Communications System II
DSP	-	Defense Support Program
FSC	-	Fleet Satellite Communications
DMSP	-	Defense Meteorological Satellite Program
SOSS	-	Satellite Ocean Surveillance System
GPS	-	Global Positioning System

In addition, a requirement for use of Radioisotope Thermo-electric Generators (RTG) on some DoD payloads was identified. The RTGs will presumably require a Thermal Control System (TCS) external to the payload for prelaunch and launching up to the time of orbital separation from the payload bay.

Some of the salient features of these DoD payloads are summarized in Table 5-3.

Table 5-3. Salient Features of DoD Payloads

	DSCS-II	DSP	FSC	DMSP	SOSS	GPS	RTG/TCS
<u>GENERAL</u>							
Handling Attitude	Vertical	Vertical	Vertical		Vertical	Vertical or Horizontal	---
Life (Years)	5	3	7			5	---
Multiple Launch	2		No	2	No	8	---
Orbit	Synchronous	Synchronous	Synchronous	450 nm $i = 98.7^\circ$	LEO $i = 80^\circ$	10,820 nm $i = 63^\circ$	---
<u>PROPULSION</u>							
Propellant	$N_2H_4$	$N_2H_4$	$N_2H_4$	$N_2H_4$	$N_2H_4$	$N_2H_4$	---
Pressurant	$N_2$	$N_2$	$N_2$	$N_2$	$N_2$	$N_2$	---
Tank Type	Spin Feed	Spin Feed	Diaphragm		Spin Feed	Diaphragm	---
Propellant Pressure (psia)	600 → 200	600 → 150	350 → 180	550		300 → 80	---
Pressurant Pressure (psia)	600 → 200	600 → 150	350 → 180	4500		300 → 80	---
Loading Site	PCR	PCR	Pad/PCR		Pad/PCR		---
Propellant Weight (lb)	122	190	168	150	828	57	---
Pressurant Weight (lb)	3	4	6	20	24		
Redundant Leak Protection	No	No	Yes	No	Yes	Yes	---
<u>OTHER</u>							
Helium	---	---	---	---	---	500 psig	---
GN <sub>2</sub> Purge				70 lb			
IMU	---	---	---	2 SCFM	---	---	---
Primary Sensor	---	---	---	2 filter 6 psig max.	---	---	---
Water Ground							
Supply	---	---	---	---	---	---	1/2 in. dia.
Return	---	---	---	---	---	---	1/2 in. dia.
Steam Vent	---	---	---	---	---	---	4 in. dia.

### 5.6.2 Fluid Services MMSE

The following items of equipment have been identified as having potential need for NASA payload fluid servicing:

1. 330-03-06-03 - Purge System
2. 330-03-07-01 - Orbiter/Payload Fluid Service Lines (Orbiter Deployed) (See Figures 5-1 and 5-2)
- (1) { 3. 330-03-07-03 - IUS Deployed Payload Fluid Service Lines (See Figure 5-3)
4. 330-03-07-04 - Payload Fluid Lines Routed via IUS/Cradle (See Figure 5-3)

Each of these items of MMSE has been reviewed for applicability to DoD payloads. The results of this review are summarized in Table 5-4. The information is also presented in the MMSE Data Sheets in Section 5.6.6.

### 5.6.3 Propulsion Systems Leakage Protection

For a Shuttle launch, it is essential that leakage of propellant and pressurant into the payload bay be prevented for reasons of safety and environmental control for accompanying payloads. All of the DoD payloads (except the RTG) use hydrazine as a monopropellant and nitrogen as a pressurant.

The FSC, SOSS, and GPS utilize isolation valves between the propellant tanks and thrusters which can provide redundant propellant leakage protection. The rest of the DoD payloads require the addition of isolation valves to provide redundant protection against leakage from thruster valves or from mechanical connections to thruster valve inlets.

---

(1) These lines are used as a set when required for IUS-launched payloads.

# Orbiter-Deployed Payloads:

Payload Umbilical Support Structure (MMSE)

Shuttle-Deployed Payload

Orbiter Preflight Service Panel  
(Near Side)

Orbiter/Payload Service  
Lines (MMSE) 330-03-07-01

Orbiter Service Panel (X<sub>0</sub> 1307)

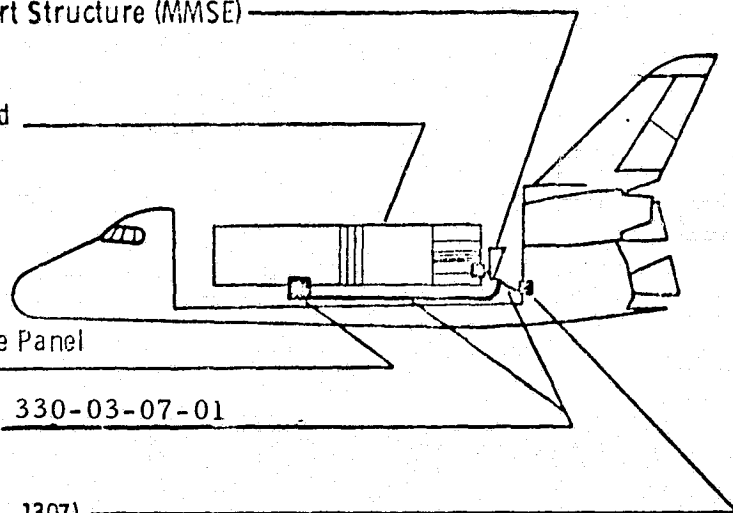


Figure 5-1. Payload/Orbiter Fluid/Gas Interfaces  
Orbiter Deployed Payloads

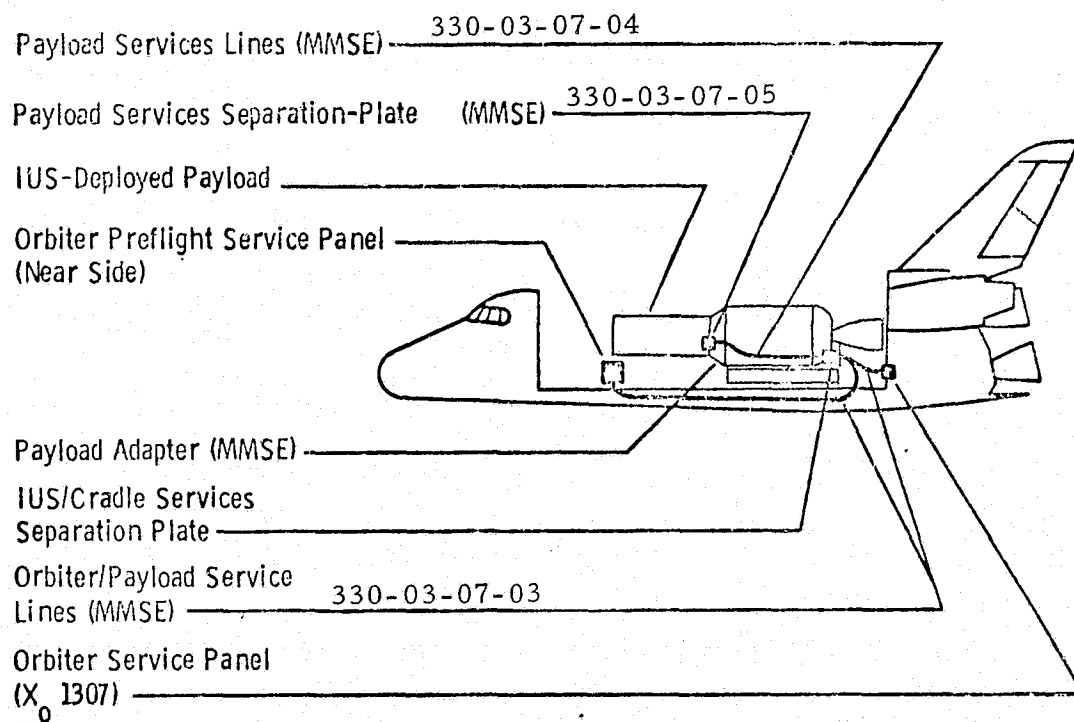


Figure 5-2. Payload/Orbiter Fluid/Gas Interfaces  
IUS Deployed Payloads

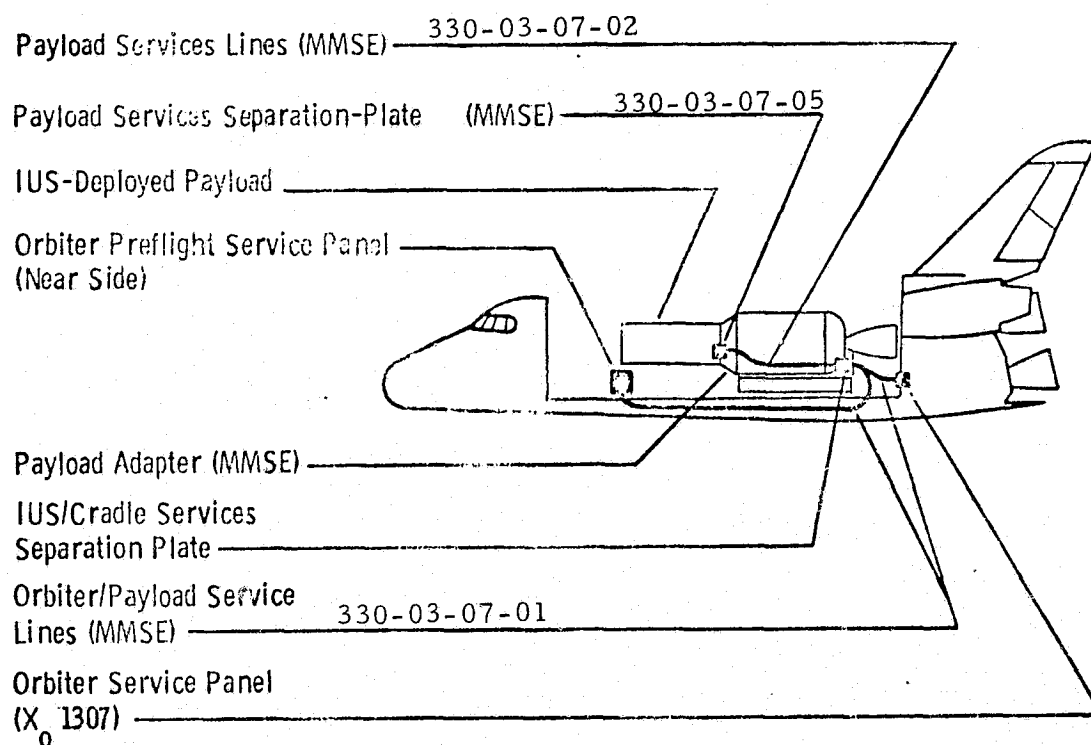


Figure 5-3. Payload/Orbiter Fluid/Gas Interfaces  
Pallet Mounted Payload

ORIGINAL PAGE IS  
OF POOR QUALITY

Table 5-4. Adaptability Matrix of MMSE to DoD Payloads

MMSE Item	DSCS-II	DSP	FSC	DMSP	SOSS	GPS	RTG
Purge System (06-03)	No <sup>(1)</sup>	No <sup>(1)</sup>	No <sup>(1)</sup>	Yes	No <sup>(1)</sup>	No <sup>(1)</sup>	No <sup>(1)</sup>
Orbiter Deployed Payload Lines (07-01)	No <sup>(2)</sup>	No <sup>(2)</sup>	No <sup>(2)</sup>	No <sup>(3)</sup>	No <sup>(3)</sup>	No <sup>(2)</sup>	No <sup>(4)</sup>
IUS Deployed Lines (07-03)	No <sup>(3)</sup>	No <sup>(3)</sup>	No <sup>(3)</sup>	No <sup>(3)</sup>	No <sup>(5)</sup>	No <sup>(3)</sup>	No <sup>(4)</sup>
Cradle Routed Lines (07-04)	No <sup>(3)</sup>	No <sup>(3)</sup>	No <sup>(3)</sup>	No <sup>(3)</sup>	No <sup>(5)</sup>	No <sup>(3)</sup>	No <sup>(4)</sup>

Notes: (Primary reason for non-requirement)

- (1) No payload requirement for purge.
- (2) IUS or Tug required for payload and equipment not used with such an upper stage.
- (3) Not required, but remote possibility a change may require propellant ( $N_2H_4$ ) dump for abort and/or  $N_2H_4$  and  $GN_2$  remote fill and drain.
- (4) Equipment does not meet payload requirements.
- (5) IUS or Tug not used, and equipment only used when an upper stage is required.

#### 5.6.4 Propellant Dump

There is no provision or requirement for propellant dump for DoD payloads. Such a requirement would require payload design changes and a potential need for MMSE.

Each DoD payload requires further study to determine that pressure safety factors are adequate for a Shuttle abort.

#### 5.6.5 Propellant Fill and Drain

Propellant fill and drain procedures for DoD payloads require further study geared to standardization. In general, it appears that propellant should be loaded and pressurized in the PCR in the launch attitude. The launch attitude should, in general, be thereafter maintained.

#### 5.6.6 MMSE Data Sheets

The Fluid Support MMSE Data Sheets are presented on pages 5-75 through 5-82.



## Fluid Support MMSE Data Sheet

1. IDENTIFICATION NO. 330-03-06-03
2. NAME Purge System
3. DATE \_\_\_\_\_
4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☒                      AUTO W IUS ☒  
    AUTO W TUG ☐                      CREW RELATED ☐                      OTHER ☐

### 5. JUSTIFICATION

Requirement:    Payloads specify maximum acoustic environment 135 dB OASPL.  
                          Orbiter payload bay acoustic environment 145 dB OASPL.

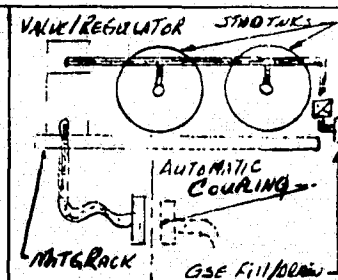
### 6. APPLICATION

POTENTIAL USERS DMSP Only

7. ALTERNATIVE SOLUTION IF NOT MMSE Pallet mounted purge system supplied by payload.

### 8. EQUIPMENT DESCRIPTION

The purge system consists of a mounting rack, valve/regulator assembly, manifold and 4 standard tanks (capacity 20, 50, 150 and 300 kg). Two tanks may be manifolded together and mounted on the rack to accommodate specific payload requirements. Fill drains are achieved through a control valve on the inlet. Deployable payloads are connected to the system through an automatic coupling. Weight and volume are TBD.



9. REMARKS Required for IMU in-flight cooling.

## Fluid Support MMSE Data Sheet

### 10. CLARIFICATION OF DESCRIPTION

The GSE fill and drain connection will attach to a nitrogen high pressure (3000 psig) line running aft to the T-O oxidizer umbilical panel.  $\text{GN}_2$  from a ground supply will be provided until launch. Pressure regulation to 4 + 2 psig is required. Flow rate control to 0 to 2 SCFM at 50° F to 90° F is required.

### 11. MODIFICATIONS TO CONSIDER:

1. Provide four 1/4-inch diameter "automatic couplings" for attachment to spacecraft (two attachments for each of two spacecraft).
2. Provide filtration downstream of regulator to 2 micron absolute or smaller particle size for the purge line to the DMSP primary sensor.
3. Provide gas temperature monitoring capability.
4. Provide pressure monitoring capability for tank pressure and for regulated pressure.
5. A shutoff valve is required upstream of the purge "automatic coupling" for T-O closure of the purge to the primary sensor.

### 12. RATIONALE FOR APPLICATION

1. The IMU on the DMSP requires coolant gas up to deployment.
2. The primary sensor of the DMSP requires moisture control and cleanliness to less than 2 micron particulate size during pre-launch operations.

### 13. OTHER:

Also connects to cabling: 330-07-05-01, -03, -04

May need connection to ground-supplied  $\text{GN}_2$ : 330-03-07-01

### Fluid Support MMSE Data Sheet

1. IDENTIFICATION NO. 330-03-07-01
2. NAME Orbiter/Payload Fluid Service Lines (Orbiter Deployed)
3. DATE \_\_\_\_\_
4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☒                      AUTO W IUS ☐  
   AUTO W TUG ☐                      CREW RELATED ☐                      OTHER ☐

5. JUSTIFICATION

Not required for DoD payloads (see item 11)

6. APPLICATION

POTENTIAL USERS None identified

7. ALTERNATIVE SOLUTION IF NOT MMSE \_\_\_\_\_

8. EQUIPMENT DESCRIPTION

Same as MMSE in June 1975 Catalog

9. REMARKS \_\_\_\_\_

10. MODIFICATIONS TO CONSIDER: Provide an interface with the 330-03-06-03  
purge system.

## Fluid Support MMSE Data Sheet

Orbiter/Payload Fluid Service Lines (Orbiter Deployed), 330-03-07-01  
(Cont'd)

### 11. RATIONALE FOR APPLICATION:

This equipment is used when the IUS or Tug are not used. The equipment, therefore, cannot even be considered for the DSCS-II, DSP, FSC, or GPS.

This equipment does not meet the requirements of various RTG/TCS concepts.

The equipment is not required for the DMSP and SOSS. The DMSP uses a nitrogen purge, but this equipment does not interface with the 330-03-06-03 purge system. The equipment is also overly complex to supply only a  $\text{GN}_2$  purge.

There is a remote possibility that a change in design or requirements could result in the need for  $\text{N}_2\text{H}_4$  dump or for  $\text{N}_2\text{H}_4$  and  $\text{GN}_2$  remote fill and drain. This could result in further consideration of the applicability of these lines.

Fluid Support MMSE Data Sheet

1. IDENTIFICATION NO. 330-03-07-03

2. NAME IUS Deployed Payload Fluid Service Lines

3. DATE \_\_\_\_\_

4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☐                      AUTO W IUS ☒  
   AUTO W TUG ☐                      CREW RELATED ☐                      OTHER ☐

5. JUSTIFICATION

Not required for DoD Payloads.

6. APPLICATION

POTENTIAL USERS None identified

7. ALTERNATIVE SOLUTION IF NOT MMSE \_\_\_\_\_

8. EQUIPMENT DESCRIPTION

Same as MMSE in June 1975 Catalog

9. REMARKS \_\_\_\_\_

## Fluid Support MMSE Data Sheet

IUS Deployed Payload Fluid Service Lines, 330-03-07-03 (Cont'd)

### 10. RATIONALE FOR APPLICATION:

This equipment does not meet the requirements of the various RTG/TCS concepts.

There is no requirement for fluid services through orbiter interfaces for the DSCS-II, DSP, FSC, or the GPS.

The SOSS does not use the IUS or the IUS cradle, so that the 330-03--7-04 cradle-mounted lines that this equipment interfaces with are completely out of consideration.

The DMSP uses a nitrogen purge, but this equipment does not interface with the 330-03-06-03 purge system. The equipment is also overly complex to supply only a  $\text{GN}_2$  purge.

There is a remote possibility that a change in design or requirements could result in the need for  $\text{N}_2\text{H}_4$  dump or for  $\text{N}_2\text{H}_4$  and  $\text{GN}_2$  remote fill and drain. This could result in further consideration of the applicability of these lines.

### Fluid Support MMSE Data Sheet

1. IDENTIFICATION NO. 330-03-07-04
2. NAME Payload Fluid Lines Routed via IUS/Cradle
3. DATE \_\_\_\_\_
4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☐                      AUTO W IUS ☒  
   AUTO W TUG ☐                      CREW RELATED ☐                      OTHER ☐

5. JUSTIFICATION

Not required for DoD payloads

6. APPLICATION

POTENTIAL USERS None identified

7. ALTERNATIVE SOLUTION IF NOT MMSE \_\_\_\_\_

8. EQUIPMENT DESCRIPTION

Same as MMSE in June 1975 Catalog

9. REMARKS \_\_\_\_\_

## Fluid Support MMSE Data Sheet

Payload Fluid Lines Routed via IUS/Cradle, 330-03-07-04 (Cont'd)

### 10. RATIONALE FOR APPLICATION:

This equipment does not meet the requirements of the various RTG/TCS concepts.

There is no requirement for fluid services through orbiter interfaces for the DSCS-II, DSP, FSC, or the GPS.

The SOSS does not use the IUS or the IUS cradle, so that cradle-mounted lines are completely out of consideration.

The DMSP uses a nitrogen purge, but this equipment does not interface with the 330-03-06-03 purge system. The equipment is also overly complex to supply only a  $\text{GN}_2$  purge.

There is the remote possibility that a change in design or requirements could result in the need for  $\text{N}_2\text{H}_4$  dump or for  $\text{N}_2\text{H}_4$  and  $\text{GN}_2$  remote fill and drain. This could result in further consideration of the applicability of these lines.



5.7

MISSION SPECIALIST AND PAYLOAD SPECIALIST  
STATIONS

Some preliminary work was accomplished relative to the application of Mission Specialist Station (MSS) and Payload Specialist Station (PSS) equipments to DoD payloads. The NASA payload specialist station equipment includes cathode ray tubes for dynamic display, a keyboard for operator interaction with the electronics unit controlling displays, and a hard copy unit. The DoD satellite interface studies showed the need for on-board equipment to assist in payload down-link testing, a spacecraft control panel, safety support equipment, and spacecraft checkout. However, as this study was underway, the USAF directive for minimum satellite/orbiter interface approaches was made and it was assumed that one of the interpretations of this directive would be a deletion of any payload specialist station equipment in the near term.

## 5.8 LAUNCH SITE MMSE

### 5.8.1 Introduction

Reference 2 identified several items of ground support equipment which had multiple use applicability to NASA KSC payloads destined for launch by the Space Transportation System (STS). Following the Martin study completion, certain of the items were selected by the KSC Payload Integration Office and recommended to NASA Headquarters for further consideration. These items have been assessed for similar applicability to DoD payloads scheduled for Shuttle launches.

### 5.8.2 Approach

Each of the MMSE items were separately examined to determine if their functional and performance characteristics would satisfy the support requirements of those payloads identified in the DoD Space Mission Model, Revision 4. Where necessary, rational projections of requirements were made for those payloads which have not progressed beyond the planning stage. Both KSC and VAFB launched programs were included.

The Martin study assigned categories to the various MMSE candidates, e.g., Category A for required items, Category B for proposed items, and Category C for optional items. Only the first two were carried through their analysis to a determination of applicability to specific payloads. This DoD evaluation was consequently limited to consideration of only those Category A and B items. The optional Category C MMSE can be analyzed for DoD applicability in follow-on effort as NASA identifies desirable candidates from that group.

ORIGINAL PAGE IS  
OF POOR QUALITY

The support equipment assembly known as Interface Verification Equipment (IVE), or Shuttle Integration Device (SID), was added to the MMSE list and evaluated. The definitive reference was that described by Rockwell International in their briefing package "Interface Verification Equipment Study (NAS 9-14000CCA-140)-IVE Concept," dated May 5, 1975. As the information is conceptual, a certain amount of latitude was taken in attributing to the equipment characteristics the full intent of the unit's purpose, i.e., to be a "standard set of hardware representing the Shuttle flight article with regard to fit, form, and function to accept a payload." (Briefing by R. T. Everline, Payload Coordination Office, "Interface Verification Equipment Study Overview," NASA-S-75-1515 A, May 5, 1975.)

#### 5.8.3 Ground Rules and Assumptions

The lack of detail, both in the MMSE specifications and in some of the payloads, and the unique processing constraints imposed by the Shuttle system, necessitated the establishment of DoD-peculiar qualifying ground rules and assumptions. These supplement those identified by Martin in their Revision 1 to the MMSE Catalogue (Launch Site), February 1975, and were as follows:

1. DoD payloads will be installed for flight in the orbiter on-pad at VAFB. At KSC, the DoD installations will be primarily in the payload changeout room, but installation in the orbiter processing facility is not ruled out.
2. Where not specifically defined, launch site MMSE capacities, pressures, voltage ranges, tolerances, and other critical characteristics will be compatible with the DoD payload requirements.
3. Sufficient quantities of the MMSE will be provided to service DoD needs, both at KSC and VAFB.

4. Payloads will be designed, or modified, to be compatible with the STS characteristics as specified in NASA publications JSC-07700, Volume XIV, Space Shuttle System Payload Accommodations, Change 10, and K-SM-14, KSC Launch Site Accommodations Handbook for STS Payloads, Revision 1. Any exceptions will be rectified by MMSE or payload-supplied equipment.
5. Tug and IUS-peculiar support requirements are not included in this assessment although the potential is noted in some cases.
6. As some payloads will be flown in a shared or multiple launch, the annual applicability rate identifies only the numbers of payloads launched and not necessarily the number of Shuttle launches.
7. Spacecraft processing at KSC will be conducted in the CCAFS SAB, SAEF No. 1 or in the PCR.
8. Payload designs will withstand loads imposed by handling and transportation in either vertical or horizontal orientation, based on the strength requirements of return and abort landings.
9. Applicability is based on "potential application." Potential application for MMSE GSE to a DoD payload means that there is a reasonable expectation that the requirement for the equipment will develop by the Shuttle era.

#### 5.8.4 DoD Applicability of NASA Launch Site MMSE

Thirteen items of the candidate MMSE were found to have DoD applicability. Table 2-3 (Section 2, pages 2-7 and 2-8 of this report) summarizes the assessments in matrix form with indications of first need date for DoD, launch site assignment, total number of payload launches, and other pertinent data. (The table is supported by the individual MMSE data sheets presented on pages 5-92 through 5-110.)

The IVE analysis was based on the expanded description given in Section 5.8.5. It should be noted that the assessment is only tentative and a considerable expansion of capabilities and functions would be necessary before DoD acceptability could be further considered. Among the unidentified provisions are crew indoctrination and training, final positioning and c.g. verifications, and the ability to conduct electrical power disconnect and reconnect.

The six items for which applicability was not identified may have applicability when the payload designs become more definitive.

The applicability assessments cannot be construed as DoD commitments. The items will need to be defined in much greater detail as to their capabilities and the assurance that they scope the range of intended DoD requirements. Further, a thorough study of cost effectiveness would be required which would consider such factors as factory equipment availability and quantity/schedule/location implications.

It is felt that there is a very real potential for cost savings in the provisioning of standardized ground support equipment, i.e., MMSE. It is recommended that these studies be carried forward to lower levels of detail in the definition of the equipment and that the implications of usage by the payloads be considered more fully.

#### 5.8.5 Interface Verification Equipment (IVE) Level I (Orbiter)

The IVE concept assessed applicability to DoD payloads is shown in Figure 5-4, and described below in outline form.

1. Intended Application:

Verify all physical and functional interfaces between the orbiter and payload as installed in the cargo bay. Also serves to support Level II and III integration.

2. Potential Application:

Prelaunch payload servicing, systems testing.

3. Functional Characteristics:

- a. Form - Provides an exact replica of the cargo bay geometry to verify that installed payloads have prescribed clearances to orbiter structure.
- b. Fit - Verifies that payload mountings, connections to orbiter servicing and checkout provisions, and locations of access panels and payload umbilicals are correctly fabricated and positioned to mate with orbiter interfaces.

c. Function

(1) Mechanical

- (a) Provides payload heat exchange at 5200, 21,500, and 29,000 Btu/hr at 45° F (7.2° C) maximum temperature.
- (b) Leak checking of fluid systems (pressure decay method)

(2) Electrical

- (a) Primary (7 KW) and secondary (5 KW) power at 27-32 vDC and 24-32 vDC.
- (b) Fuel cell software simulation

(3) Avionic

- (a) Payload Specialist Station (PSS) console for performance of payload orbital checkout and control functions.
- (b) Mission Specialist Station (MSS) console for verification of orbiter payload control functions and adequacy of caution and warning provisions.

- (c) Control, monitoring, and routing of signal flow to/from payload to GSE and data processing equipment.
  - (d) Flight software validation utilizing orbiter TLM PCM system.
- 4. Use Location: KSC, VAFB
- 5. Duration of Use:  
Variable dependent on payload/orbiter interface complexity. Upper limit is approximately 12 days based on 2-week launch centers and single IVE.
- 6. Mobility: None, fixed installation
- 7. Installation Requirements:  
Standard and payload-unique hoist and handling support equipment; payload-unique servicing and checkout equipment; ground orbiter access panels and umbilicals; and in-flight cables, equipment, and umbilicals. (All as pertaining to in-bay payload operations.)
- 8. Subsystem Applications: All
- 9. Spacecraft Modifications Required:  
Automated payload checkout capability is required. Horizontal hoisting and mating provisions.
- 10. Applicability Assessment:
  - a. NASA Payloads - All
  - b. DoD Payloads - All
- 11. Limitations:
  - a. The IVE is located only at the launch site and may be limited to a single installation. Payloads (other than standardized upper stages and spacecraft) must have all orbiter interfaces verified before leaving the factory in order to conform to the success-oriented philosophy of the STS. Therefore, each payload supplier has to provision

the necessary verification equipment anyway to assure orbiter compatibility before arrival at the launch site. The IVE, in cases of upper stage applications, verifies the orbiter interface of the mated configuration and serves as a reverification of the spacecraft interfaces when there is no upper stage.

- b. Current design concept is for horizontal payload installations.

12. Cost: \$1M (Assumed)

13. Data Source:

Briefing, Interface Verification Equipment Study  
(NAS G-14000 CCA-140) - IVE Concept, Rockwell  
International, May 5, 1975.

#### 5.8.6 MMSE Data Sheets

The individual Launch Site MMSE Data Sheets are presented on pages 5-92 through 5-110.

ORIGINAL PAGE IS  
OF POOR QUALITY



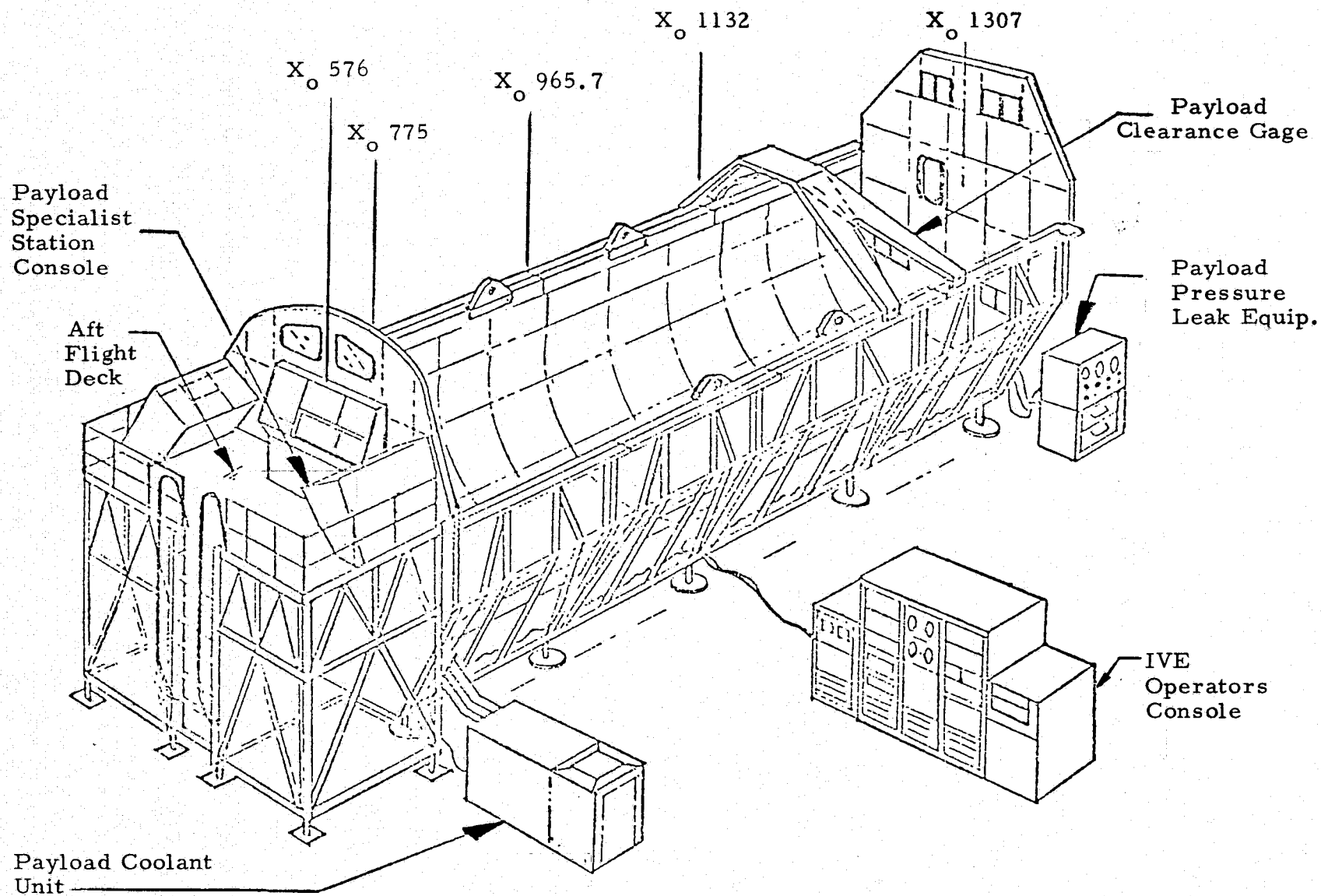


Figure 5-4. Shuttle/Orbiter Payload Interface Verification Equipment (IVE) Concept

## Launch Site MMSE Data Sheet

1. IDENTIFICATION NO. KMA-MH-06
2. NAME Access Platform, Spacecraft Assembly Stand, Vertical
3. DATE \_\_\_\_\_
4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☒                      AUTO W IUS ☒  
    AUTO W TUG ☒                      CREW RELATED ☐                      OTHER ☐

5. JUSTIFICATION

These platforms will be used to access spacecraft in the spacecraft vertical assembly stand and to access kickstages with or without spacecraft in the kickstage assembly/test stand. Avoids provisions of launch site stands by each user. Avoids installation and removal of stands for each new payload.

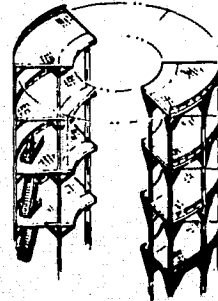
6. APPLICATION

POTENTIAL USERS DSCS- II, FSC, DSO, GPS, DMSP, STP plus 3 others.

7. ALTERNATIVE SOLUTION IF NOT MMSE Use existing user-supplied stands for all DoD transition payloads.

8. EQUIPMENT DESCRIPTION

These access platforms will consist of two sets of multilevered scaffolding type platforms. Levels will be at approximately 8, 16, and 24 feet. One set will accommodate spacecraft to 15' diameter, having an I.D. of 16' with flip up or bolt on extensions to reduce diameter to 11'. A second set will accommodate spacecraft or kickstages to 10' diameter, having an I.D. of 11', reducible to 6'. The platforms will be modular in construction. Sections will be separated to allow spacecraft removal. Provision for mounting over the 15' diameter base plate of the spacecraft vertical assembly stand will be included in the smaller access platform.



9. REMARKS Usable at both KSC and VAFB. Cost effectiveness primarily dependent on new payloads which require provisioning and elimination of duplicate stands for launch site use. Not applicable to PCR per assumption facility stands will be supplied. STP (shared) is a small, secondary payload which would not require such an extensive stand. STP (dedicated) is too long at 57'. Also, any multiple spacecraft launches will probably involve a stack exceeding the stand's height capacity (TBD).

## Launch Site MMSE Data Sheet

1. IDENTIFICATION NO. KMA-MH-10
2. NAME Container, Payload
3. DATE \_\_\_\_\_
4. CATEGORY:                      SORTIE ☒                      AUTOMATED ☒                      AUTO W IUS ☒  
    AUTO W TUG ☒                      CREW RELATED ☐                      OTHER ☐

5. JUSTIFICATION

This container will house all configurations of payloads during transfer from the various payload processing facilities to the orbiter (OPF or pad) and return. Provides mating with PCR and environmental maintenance during loading and unloading at PCR.

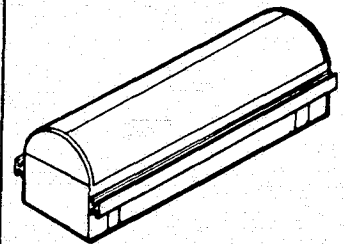
6. APPLICATION

POTENTIAL USERS DSCS- II, FSC, DSP, GPS, STP plus 4 others.

7. ALTERNATIVE SOLUTION IF NOT MMSE Payloads could be hoisted directly into the PCR from their own factory-to-launch site containers per current practice. Also, launch site movement can be supported by each payload's shipping provisions.

8. EQUIPMENT DESCRIPTION

This container will be sized equal to the orbiter payload bay. Pickup points/retention fittings will be similar in type, quantity and location to the orbiter. Access doors will be along the top of the container and operate identical to the orbiter doors relative to allowable envelopes and clearances. Viewports will be provided and provisions for personnel access to the interior from ground level. Included are service panels<sup>(1)</sup>, tie downs, and lift points to allow rotation of the loaded/unloaded container. Its closure device and external sizing will be compatible with the PCR. One end is hinged to allow vertical P/L installation.



9. REMARKS Not applicable to VAFB as payload installation does not involve containerization, and factory to launch site equipment will suffice for on-site movement. KSC applicability subject to requirement to maintain PCR environment during installation into that facility, and the container is the only means for installation.

- (1) To allow interfacing with ground power, environmental conditioning, environmental monitoring, and RTG cooling systems.

## Launch Site MMSE Data Sheet

1. IDENTIFICATION NO. KMA-MH-11
2. NAME Container, Payload Element
3. DATE \_\_\_\_\_
4. CATEGORY:                      SORTIE ☒                      AUTOMATED ☒                      AUTO W IUS ☒  
    AUTO W TUG ☒                      CREW RELATED ☐                      OTHER ☐

5. JUSTIFICATION

This container will house spacecraft payloads (less than 25 feet in length) during transfers from building to building within the launch site. As such, it will allow use of smaller spacecraft processing facilities and reduce the number of full size containers required.

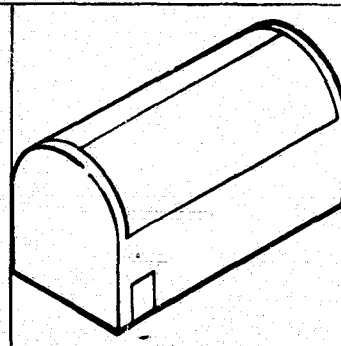
6. APPLICATION

POTENTIAL USERS DSCS- II, FSC, DSP, STP, GPS, DMSP, plus 3 others.

7. ALTERNATIVE SOLUTION IF NOT MMSE Each payload uses own transport container provisions.

8. EQUIPMENT DESCRIPTION

This container will be sized for a payload envelope of 15' diameter by 25' length. Pickup points and retention fittings will be similar in type and location to those provided in the orbiter payload bay. Closure shall be identical to orbiter closure relative to allowable envelopes and clearance. The container shall have viewports to allow viewing of interior blindspots and shall be provided with personnel access to the interior from ground level. It shall contain interface service panels to allow interface with the appropriate ground power, environmental conditioning, environmental monitoring, and RTG cooling systems. It shall be outfitted with appropriate tie-down and lifting capabilities.



9. REMARKS Applicability dependent on use in lieu of individual factory to launch site shipping provisions. Also applicable to IUS movements. Not applicable if multiple payload stacks exceed 25'.

## Launch Site MMSE Data Sheet

1. IDENTIFICATION NO. KMA-MH-19
2. NAME Fixture, Payload Handling
3. DATE \_\_\_\_\_
4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☒                      AUTO W IUS ☒  
    AUTO W TUG ☒                      CREW RELATED ☐                      OTHER ☐

5. JUSTIFICATION

Used on-line for horizontal handling of large payloads (spacecraft, multiples, or TUG/IUS).

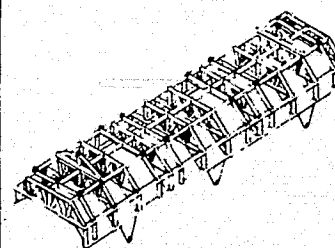
6. APPLICATION

POTENTIAL USERS Two "other" payloads.

7. ALTERNATIVE SOLUTION IF NOT MMSE Each payload provides own handling equipment. Transition payloads can use existing provisions.

8. EQUIPMENT DESCRIPTION

The fixture (strong back) will be a rigid frame device consisting of beams, cables, attach hook devices, and rings adjustable to accommodate varying lengths and shifting c. g. of payloads up to 15' diameter, 60' length, and 65,000 lb weight. It will interface with the payload on a non-interference basis such that engagement and load transference to attachment/retention points can occur while the handling fixture is still attached. It will support an IUS/Tug with payload by attachment to the carrier only, and automated by attachment to the spacecraft or to a spacecraft-orbiter adapter. It will not induce any bending or twisting loads on any payload element.



9. REMARKS Noted applicability is based on size and/or weight. Payloads with Tug/IUS are assumed to be handled vertically. Additional use may develop as multiple spacecraft stacks and return spacecraft are defined.

## Launch Site MMSE Data Sheet

1. IDENTIFICATION NO. KMA-MH-27
2. NAME Sling Set, Multipurpose
3. DATE \_\_\_\_\_
4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☒                      AUTO W IUS ☒  
    AUTO W TUG ☒                      CREW RELATED ☐                      OTHER ☐

5. JUSTIFICATION

This set will provide general purpose lifting capability in conjunction with cranes or building hoists.

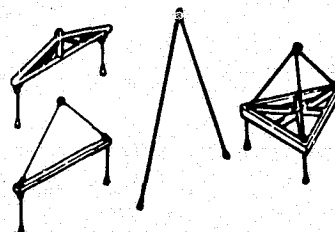
6. APPLICATION

POTENTIAL USERS DSCS-II, FSC, DSP, STP, DMSP, GPS, plus 5 others.

7. ALTERNATIVE SOLUTION IF NOT MMSE Payloads provide own slings as used in factory.

8. EQUIPMENT DESCRIPTION

This set will consist of a variety of spreader bars, hooks, clevises, drop cables, and straps which will be used to lift items for which specific sling sets have not been designated. This would include such items as test or service sets, shipping containers, and spacecraft for which spacecraft contractors have not provided a special sling.



9. REMARKS Questionable cost effectiveness unless standardized system can replace in-factory provisions or duplication of special slings at launch site is avoided.

## Launch Site MMSE Data Sheet

1. IDENTIFICATION NO. KMA-MH-34
2. NAME Stand, Spacecraft Assembly, Vertical
3. DATE \_\_\_\_\_
4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☒                      AUTO W IUS ☒  
    AUTO W TUG ☒                      CREW RELATED ☐                      OTHER ☐

### 5. JUSTIFICATION

This stand will support automated spacecraft in the vertical orientation for final assembly and test prior to payload buildup. It will support multiple spacecraft with adapters for multispacecraft buildup and alignment prior to installation on the Tug/IUS.

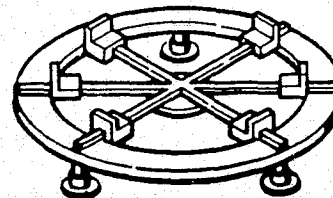
### 6. APPLICATION

POTENTIAL USERS DSCS-II, FSC, DSP, STP, GPS, DMSP, plus 5 others.

7. ALTERNATIVE SOLUTION IF NOT MMSE Each payload provides own stand.

### 8. EQUIPMENT DESCRIPTION

This stand will consist of a 15' diameter rigid base plate with leveling legs on which are mounted six radial rails spaced 60 degrees apart running to the edge of the base plate. Payload interface fittings are mounted on the rails and slide radially to accommodate all spacecraft diameters.



9. REMARKS May require use of adapter if spacecraft support points do not match the six rails of the stand. Assumes no payload requires horizontal processing, which may be required for some payloads.

## Launch Site MMSE Data Sheet

1. IDENTIFICATION NO. KMA-MH-39

2. NAME Transporter, Payload Container, Horizontal

3. DATE \_\_\_\_\_

4. CATEGORY:

SORTIE ☐  
AUTO W TUG ☒

AUTOMATED ☒  
CREW RELATED ☐

AUTO W IUS ☒  
OTHER ☐

5. JUSTIFICATION

This unit will be used to transport the payload container in the horizontal attitude from payload processing facilities to the OPF or pad and return.

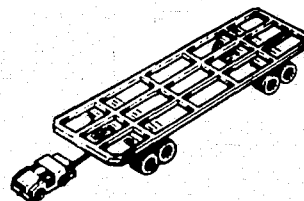
6. APPLICATION

POTENTIAL USERS DSCS-II, FSC, DSP, GPS, STP, plus 4 others

7. ALTERNATIVE SOLUTION IF NOT MMSE Use existing transporters for transition payloads.

8. EQUIPMENT DESCRIPTION

The transporter will support the loaded or unloaded payload container in the horizontal attitude. The unit will have a flat bed (approximately 18' wide by 65' long) with tie-down provisions included. It will be towable from either end by a prime mover, have steerable front and rear wheels, have self-contained braking and stabilization jacking provisions, and a suspension system to minimize over the road shock and vibration. It will have provisions for the accompanying transport of support equipment required by the payload during transport such as environmental conditioning and monitoring equipment.



9. REMARKS Applicability may be limited to KSC for containerized payload transport. VAFB applicability dependent on finalization of flow procedures and use of KSC container (KMA-MH-10).



## Launch Site MMSE Data Sheet

1. IDENTIFICATION NO. KMA-MH-41
2. NAME Transporter, Payload Container, Vertical/Element
3. DATE \_\_\_\_\_
4. CATEGORY:                      SORTIE ☒                      AUTOMATED ☒                      AUTO W IUS ☒  
    AUTO W TUG ☒                      CREW RELATED ☐                      OTHER ☐

5. JUSTIFICATION

This unit will be used at KSC to transport the payload container from the TPF or SAEF 1 to the pad and return and to transport the payload element container between processing facilities.

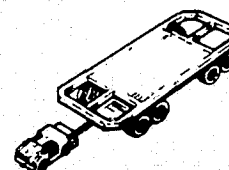
6. APPLICATION

POTENTIAL USERS DSCS-II, FSC, DSP, GPS, STP, plus 4 others.

7. ALTERNATIVE SOLUTION IF NOT MMSE \_\_\_\_\_

8. EQUIPMENT DESCRIPTION

This transporter will support the loaded or unloaded payload container in the vertical attitude. It will also support the payload element container in the horizontal attitude. The unit will have a flat bed (approximately 18' wide and 30' long) with tie-down provisions included. It will be towable from either end by a prime mover, have steerable front and rear wheels, have self-contained braking and stabilization jacking provisions, and a suspension system to minimize over the road shock and vibration. It will have transport provisions for accompanying support equipment required by the payload.



9. REMARKS Applicability limited primarily to KSC. VAFB applications unknown pending definition of off-line payload build-up requiring vertical transport to pad.

## Launch Site MMSE Data Sheet

1. IDENTIFICATION NO. KMA-MT-07
2. NAME Simulator, Payload, Mechanical
3. DATE \_\_\_\_\_
4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☒                      AUTO W IUS ☒  
    AUTO W TUG ☒                      CREW RELATED ☐                      OTHER ☐

5. JUSTIFICATION

This simulator will be used for payload facility and support equipment verification prior to processing a flight payload.

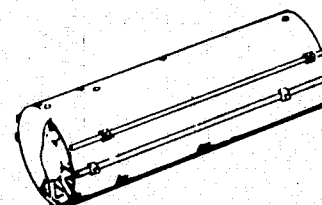
6. APPLICATION

POTENTIAL USERS Not Applicable

7. ALTERNATIVE SOLUTION IF NOT MMSE \_\_\_\_\_

8. EQUIPMENT DESCRIPTION

This unit will consist of a 15' diameter by 60' long shell with a core tank approximately 5' in diameter. The core tank would be compartmentalized and would be filled with water as needed to adjust weight and center of gravity. The entire unit would be segmented in 10, 20, and 30 foot lengths. Sliding pickup points would mount on rails to simulate orbiter attach and lifting fixture interfaces at any desired location.



9. REMARKS Applicable to both KSC and VAFB.

## Launch Site MMSE Data Sheet

1. IDENTIFICATION NO. KMB-AH-30
2. NAME Stand, Work, Payload Assembly/Test, Horizontal
3. DATE \_\_\_\_\_
4. CATEGORY:                      SORTIE ☐                      AUTOMATED ☒                      AUTO W IUS ☐  
    AUTO W TUG ☐                      CREW RELATED ☐                      OTHER ☐

5. JUSTIFICATION

This stand is used to provide access and support to automated payloads for assembly, disassembly, and Level I interface simulation activities.

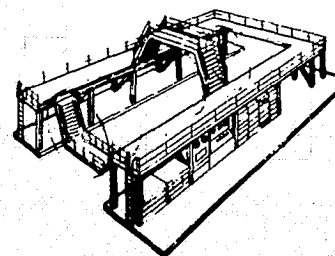
6. APPLICATION

POTENTIAL USERS DSCS-II, FSC, DSP, GPS, STP, DMSP, plus 5 others.

7. ALTERNATIVE SOLUTION IF NOT MMSE Each payload provides own stands and orbiter interface simulation verification.

8. EQUIPMENT DESCRIPTION

The workstand is a horizontal support structure which supports and provides access to individual and integrated automated payloads. Retention fittings are similar in type, quantity, and location to those provided in the orbiter. Access is provided for the entire length of the workstand on both sides as well as the full width at both ends, for payload heights to 15', and to all required positions within the envelope of the workstand. The stand includes cable trays for routing of electrical and fluid lines and interface panels for simulating the orbiter to payload interfaces. Test equipment needed to perform Level I interface simulation is included.



9. REMARKS Desirable item for use at both KSC and VAFB but retention fittings should be identical, not just similar to those in the orbiter. Spacecraft assembled vertically at the launch site (DSCS-II) would be used primarily for the interface verification provisions. STP assumed to utilize NASA primary payload provisions.

## Launch Site MMSE Data Sheet

1. IDENTIFICATION NO. KMB-MS-01
2. NAME Set, Hydrazine, Service
3. DATE \_\_\_\_\_
4. CATEGORY:                      SORTIE ☒                      AUTOMATED ☒                      AUTO W IUS ☒  
    AUTO W TUG ☒                      CREW RELATED ☐                      OTHER ☐

5. JUSTIFICATION

This equipment is used to drain, flush, purge, and fill as required the hydrazine systems of orbiter payloads at the Tug and Hazard Processing facilities.

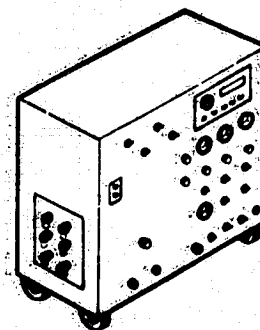
6. APPLICATION

POTENTIAL USERS DSCS-II, FSC, DSP, STP, GPS, DMSP plus 5 others.

7. ALTERNATIVE SOLUTION IF NOT MMSE \_\_\_\_\_

8. EQUIPMENT DESCRIPTION

This set is a self-contained unit that will contain fluid storage and refill capability, all plumbing and fittings, service hoses, gaging, pumps, regulators, valves, filters, and metering to accomplish fill, drain, flush, and purge of payload hydrazine systems. Three separate systems are included so that MMH,  $N_2H_4$ , and  $N_2O_4$  can be handled independently. The set is movable and includes provisions to utilize facility power and  $GN_2$ .



9. REMARKS SSCS, DSSS, STP (shared) and STP (dedicated) are new payloads for which hydrazine use is assumed. Also assumes quantities, rates, accuracies are compatible with DoD needs. Use requires standardization of payload connections.

## Launch Site MMSE Data Sheet

1. IDENTIFICATION NO. KMB-MS-02
2. NAME Set, Instrument Gas, Service
3. DATE \_\_\_\_\_
4. CATEGORY:                      SORTIE ☒                      AUTOMATED ☒                      AUTO W IUS ☐  
    AUTO W TUG ☐                      CREW RELATED ☐                      OTHER ☐

5. JUSTIFICATION

This equipment is used to supply instrument gas, as required, to orbiter payloads at the pad and at the processing facilities.

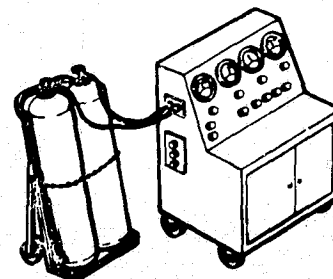
6. APPLICATION

POTENTIAL USERS TBD

7. ALTERNATIVE SOLUTION IF NOT MMSE \_\_\_\_\_

8. EQUIPMENT DESCRIPTION

This set is a self-contained unit that will house all the necessary tanks, valves, regulators, filters, flex lines, and fittings to accomplish instrument gas transfer to required payloads. Tanks will be sized to allow full servicing with at least 50% reserve. The system is equipped with variable flow and pressure capability, automatic and manual safety relief valves, a system status display panel, a gas filtering system, and tank refill capability. The set is portable. ...



9. REMARKS Lack of payload definition precludes applicability assessment.

## Launch Site MMSE Data Sheet

1. IDENTIFICATION NO. KMB-MS-03
2. NAME Set, Liquid Helium, Service
3. DATE \_\_\_\_\_
4. CATEGORY:                      SORTIE ☒                      AUTOMATED ☒                      AUTO W IUS ☒  
    AUTO W TUG ☒                      CREW RELATED ☐                      OTHER ☐

5. JUSTIFICATION

This equipment is used to supply liquid helium, as required, to the orbiter payloads at the pad and payload processing facilities.

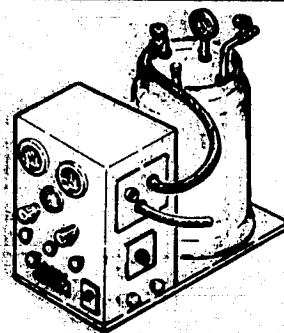
6. APPLICATION

POTENTIAL USERS TBD

7. ALTERNATIVE SOLUTION IF NOT MMSE \_\_\_\_\_

8. EQUIPMENT DESCRIPTION

The Liquid Helium Service Set is a self-contained unit that will consist of a liquid helium dewar, insulated transfer lines, valves and payload fittings, instrumentation, and gaseous helium transfer pressurization and purge accommodations. This unit is portable and includes provisions to utilize facility power.



9. REMARKS Lack of payload definition precludes applicability assessment.

## Launch Site MMSE Data Sheet

1. IDENTIFICATION NO. KMB-MS-04
2. NAME Set, Liquid Hydrogen, Service
3. DATE \_\_\_\_\_
4. CATEGORY:                      SORTIE ☒                      AUTOMATED ☒                      AUTO W IUS ☐  
    AUTO W TUG ☐                      CREW RELATED ☐                      OTHER ☐

5. JUSTIFICATION

This equipment is used to supply liquid hydrogen, as required, to orbiter payloads at the spacecraft and Spacelab processing facilities.

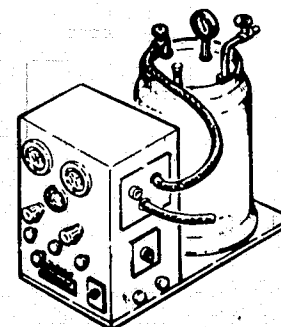
6. APPLICATION

POTENTIAL USERS TBD

7. ALTERNATIVE SOLUTION IF NOT MMSE \_\_\_\_\_

8. EQUIPMENT DESCRIPTION

The set is a self-contained unit that will house all the necessary tanks, valves, filters, regulators, lines, and fittings to accomplish the required drain and fill functions. Tanks will be sized to allow full servicing of required payloads with at least 50% reserve. The system will be equipped with a variable flow and pressure capability, automatic and manual safety cutoff valves, a system status display system, and a tank refill capability. The set is movable.



9. REMARKS Lack of payload definition precludes applicability assessment.

## Launch Site MMSE Data Sheet

1. IDENTIFICATION NO. KMB-MS-09
2. NAME Cart, Payload Purge
3. DATE \_\_\_\_\_
4. CATEGORY:                      SORTIE ☒                      AUTOMATED ☒                      AUTO W IUS ☒  
    AUTO W TUG ☒                      CREW RELATED ☐                      OTHER ☐

5. JUSTIFICATION

This item of equipment is used to provide a positive pressure internal to the payload to maintain internal cleanliness.

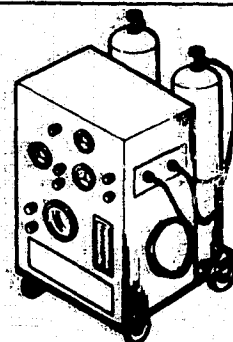
6. APPLICATION

POTENTIAL USERS DSP, FSC, DMSP

7. ALTERNATIVE SOLUTION IF NOT MMSE Each payload supplies own provisions.  
Bagging and covers could also be used.

8. EQUIPMENT DESCRIPTION

The Purge Cart will be a mobile self-contained unit to supply small quantities of gaseous nitrogen or helium, as required, to purge a payload internally. The unit will contain gas supplies, gages, valves, regulators, hoses, and fittings to interface with payloads or the payload container.



9. REMARKS Lack of design definition precludes designation of other payloads as potential users. Also, the actual degree of contamination control will be dependent on finalized STS provisions and operational experience.



## Launch Site MMSE Data Sheet

1. IDENTIFICATION NO. KMB-SS-03
2. NAME Set, Liquid Nitrogen, Service
3. DATE \_\_\_\_\_
4. CATEGORY:                      SORTIE ☒                      AUTOMATED ☐                      AUTO W IUS ☐  
    AUTO W TUG ☐                      CREW RELATED ☐                      OTHER ☐

5. JUSTIFICATION

This equipment is used to supply liquid nitrogen, as required, to orbiter payloads at the pad and Spacelab processing facility.

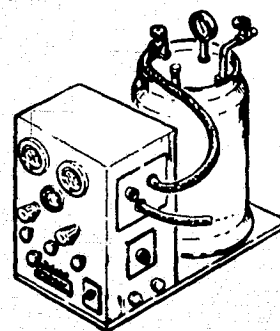
6. APPLICATION

POTENTIAL USERS TBD

7. ALTERNATIVE SOLUTION IF NOT MMSE \_\_\_\_\_

8. EQUIPMENT DESCRIPTION

The set is a self-contained unit that will house all the necessary tanks, valves, filters, regulators, lines, and fittings to accomplish the required drain and fill functions. Tanks will be sized to allow full servicing of required payloads with at least 50% reserve. The system will be equipped with a variable flow and pressure capability, automatic and manual safety cutoff valves, a system status display system, and a tank refill capability. The set is movable and includes provisions to utilize facility power.



9. REMARKS Lack of payload definition precludes applicability assessment.

## Launch Site MMSE Data Sheet

1. IDENTIFICATION NO. KMB-SS-04
2. NAME Set, Liquid Neon, Service
3. DATE \_\_\_\_\_
4. CATEGORY:                      SORTIE ☒                      AUTOMATED ☐                      AUTO W IUS ☐  
    AUTO W TUG ☐                      CREW RELATED ☐                      OTHER ☐

**5. JUSTIFICATION**

This equipment is used to supply liquid Neon, as required, to orbiter payloads at the Spacelab processing facility.

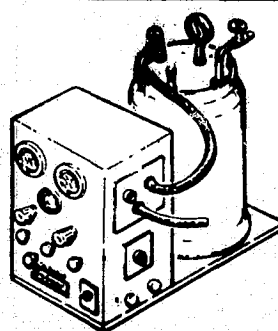
**6. APPLICATION**

POTENTIAL USERS TBD

**7. ALTERNATIVE SOLUTION IF NOT MMSE** \_\_\_\_\_

**8. EQUIPMENT DESCRIPTION**

The set is a self-contained unit that will house all the necessary tanks, valves, filters, regulators, lines, and fittings to accomplish the required drain and fill functions. Tanks will be sized to allow full servicing of required payloads with at least 50% reserve. The system will be equipped with a variable flow and pressure capability, automatic and manual safety cutoff valves, a system status display system, and a tank refill capability. The set is movable and includes provisions to utilize facility power.



**9. REMARKS** Lack of payload definition precludes applicability assessment.

## Launch Site MMSE Data Sheet

1. IDENTIFICATION NO. KMB-SS-05
2. NAME Set, Liquid Oxygen, Service
3. DATE \_\_\_\_\_
4. CATEGORY:                      SORTIE ☒                      AUTOMATED ☐                      AUTO W IUS ☐  
    AUTO W TUG ☐                      CREW RELATED ☐                      OTHER ☐

### 5. JUSTIFICATION

This equipment is used to supply liquid oxygen, as required, to orbiter payloads at the Spacelab processing facility.

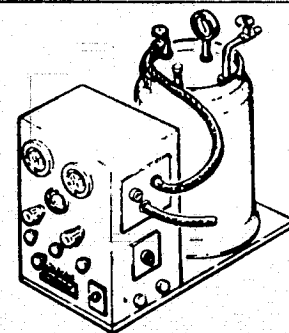
### 6. APPLICATION

POTENTIAL USERS TBD

### 7. ALTERNATIVE SOLUTION IF NOT MMSE

### 8. EQUIPMENT DESCRIPTION

The set is a self-contained unit that will house all the necessary tanks, valves, filters, regulators, lines, and fittings to accomplish the required drain and fill functions. Tanks will be sized to allow full servicing of required payloads with at least 50% reserve. The system will be equipped with a variable flow and pressure capability, automatic and manual safety cutoff valves, a system status display system, and a tank refill capability.



### 9. REMARKS Lack of payload definition precludes applicability assessment.

### Launch Site MMSE Data Sheet

1. IDENTIFICATION NO. \_\_\_\_\_
2. NAME Interface Verification Equipment (IVE)<sup>(1)</sup>
3. DATE \_\_\_\_\_
4. CATEGORY:                      SORTIE ☒                      AUTOMATED ☒                      AUTO W IUS ☒  
   AUTO W TUG ☒                      CREW RELATED ☐                      OTHER ☐

5. JUSTIFICATION

This equipment is used to provide final verification of the payload interfaces with the orbiter as to form, fit, and function.

6. APPLICATION

POTENTIAL USERS DSCS-II, FSC, DSP, STP, GPS, DMSP, plus 5 others

7. ALTERNATIVE SOLUTION IF NOT MMSE Users will have to provide their own verification equipment.

8. EQUIPMENT DESCRIPTION

The equipment consists of a large stand which duplicates all orbiter cargo bay interfaces, the aft orbiter cabin with MSS and PSS installations, and a complement of peripheral equipment to provide control display, measurement, and simulation of functional interfaces and interfacing with payload-unique support equipment.

9. REMARKS The use of this equipment must be coordinated with Item KMB-AH-30, Stand Work, Payload Assembly/Test, Horizontal. If the latter is also implemented, it will serve the purpose of Level I verification for payloads not using the IUS/Tug or for verification prior to IUS/Tug mating. The utility of provisioning both items needs to be addressed.

(1) As defined by Rockwell International in Interface Verification Equipment Study (NAS 9-14000 CCA-140). 5 May 1975.

## 6. PAYLOAD/IUS INTERFACE (MMSE) STRUCTURE STUDY

Fifteen of the MMSE items selected as candidates for application to DoD payloads fall into the category of payload/IUS interface equipments. These include adapters, mounting beams, spacers, service plates, and a separation latch and push-off assembly. Of the 12 DoD payloads considered, nine require an IUS. Several of these nine payloads will be transitioning to the IUS from Transtage. Currently the IUS physical interface with the payload is the Transtage interface. If these payloads were to fly singly on IUS, i. e., not share the IUS flight with another payload, the physical Transtage interface could be used without MMSE assuming that the interface loads and umbilical requirements are compatible. However, there is an excess payload weight capability available in the generic IUS performance map for all DoD synchronous equatorial payloads if flown singly. The MMSE is designed to support multiple payloads on the IUS. The payload/IUS interface structure in the MMSE catalog also has the effect of standardizing the interface so that payloads could be flown singly (with ballast) or sharing the IUS flight without changing the interface or payload support. If the MMSE IUS payload interface equipments are accepted and used, payload flight sharing is enhanced by having payload interchangeability not only between DoD payloads but also NASA payloads.

A brief conceptual study was made to identify the MMSE which would be used in this situation on DoD payloads. Since in this study the applications of interest are those which occur early in the Shuttle era, only the IUS (pre-Tug) equipment is considered. MMSE described in the catalog is used directly whenever possible. If modifications in the MMSE could either enhance their applicability to DoD

payloads or extend their application to additional payloads, the modifications which would accomplish this are described.

For this task an IUS which uses solid rocket propellant engines in a two-stage configuration was considered. In the case of the payload mounting beam, it was assumed that the payload spacer will separate from the beam by means of explosive bolts. The separation mechanism was not described in the catalog. Discussions with Martin Marietta resulted in the assumptions for this study.

IUS payload configurations studied were: (1) DSCS payload on IUS, (2) DSCS payloads in tandem on IUS, (3) DSP<sup>(1)</sup> payload on IUS, (4) DSCS plus DSP<sup>(1)</sup> payloads in tandem on IUS, (5) FSC payload on IUS, (6) two FSC payloads in tandem on IUS, (7) FSC and DSCS payloads in tandem on IUS, and (8) four GPS payloads on IUS, tandem and side-by-side.

The study consisted of three tasks:

1. Select the MMSE which could be applied and accomplish a design weight statement summarizing the IUS payload weights with MMSE included
2. For the multiple configurations where orbiter payload bay dimensional constraints could be a problem, conceptual layouts were made of the IUS plus payloads
3. Modifying MMSE concepts to be more compatible with multiple DoD payloads.

The application of MMSE to DoD payloads for this IUS/payload interface structure study was accomplished using the application rules described on Page 95 of Reference 15. The payload definitions used were those from References 6 through 10. This first-cut at the

---

(1) Without payload shroud.

applications resulted in the design described by the weight statement shown in Tables 6-1, 6-2, and 6-3. These data show that 227 or 318 kg (500 or 700 lb) can be saved by going from the 4.5 m (176 in) diameter spacer (see Table 6-1) to the smaller diameter spacer for the multiple payloads. However, the DoD payloads which the spacer fits over are 2.67 to 2.78 m (105 to 109.4 in) in diameter. The 3.0 m (120 in) diameter spacer currently described in the MMSE list might work for the 2.67 m (105 in) diameter payload but is too small a diameter for the other payloads. It is therefore recommended (and Table 6-2 data reflects) that the 3.0 m (120 in) spacer be increased to 3.5 m (138 in). The length was maintained at 4.3 m (170 in) so that the applicability to the NASA mission model estimated by Martin would remain valid.

For the configuration supporting DSP and DSCS in tandem, the 4.3 m (170 in) long spacer required the payload package to exceed the length of the payload bay available to it. A shortened version of the spacer (XPLS-3) is therefore recommended for consideration by NASA as a possible MMSE item (see Table 6-2 and Figure 6-1). If a payload shroud is needed for DSP (see pages 5-14, 5-35), the integration of a shroud into the multiple payload configuration for DSP needs to be studied.

The FSC and DSCS-II payloads in tandem configuration is shown in Figure 6-2. The 4.3 m (170 in) long spacer is shown. The DSCS plus DSP payloads in tandem are shown in Figure 6-1. The shortened spacer [3.3 m (130 in) long version] is shown. Four GPS satellites mounted on the IUS, again using MMSE, are shown in Figure 6-3. In order to obtain rattle room in this configuration, the 4.5 m (176 in) diameter beam described in the MMSE catalog for payload mounting beam XPMB-1 (side-by-side payloads) was inadequate. The diameter of the payload mounting beam shown in the figure has been reduced.

ORIGINAL PAGE IS  
OF POOR QUALITY

Table 6-1a. IUS/Payload Support MMSE Utilization  
4.5 m Diameter Spacer, Payload Mounting  
Beam and Associated Equipment

Satellites On IUS	DSCS-II	Two DSCS-II	DSP	DSP + DSCS-II	FSC	Two FSC	FSC + DSCS-II
Total Satellite Length (m)	2.62	5.18	6.86	9.47	4.88	9.75	7.62
Satellite Diameter (m)	2.74	2.74	2.78	2.78	2.67	2.67	2.74
Total Satellite Weight (kg) <sup>(1)</sup>	628	1,255	1,093	1,720	844	1,088	1,472
MMSE Weights (kg)							
XPMB-2	113		113		113		
PMB-2		169		169 <sup>(2)</sup>		169	169 <sup>(3)</sup>
SLP-1	29	29	29	29	29	29	29
PIA-3	39	39	39	39	39	39	39
PSP-1	6	6	6	6	6	6	6
PSP-2	3	3	3	3	3	3	3
Top Deck Subtotal	(189)	(245)	(189)	(245)	(189)	(245)	(245)
PLS-4		123		123			123
PLS-6						162	
PIA-3		39		39		39	39
PMB-2		169		169 <sup>(4)</sup>		169	169 <sup>(4)</sup>
ITA-1		110		110		110	110
Separation System <sup>(5)</sup>		5		5		5	5
SLP-1		29		29		29	29
PSP-1		6		6		6	6
PSP-2		3		3		3	3
Lower Deck Subtotal		(484)		(484)		(523)	(484)
Total MMSE Weight (kg)	189	729	189	729	189	768	729
Gross Weight (kg)	816	1,984	1,282	2,449	1,033	2,456	2,200

- (1) Has beef-up, no adapter.  
 (2) Supports DSP.  
 (3) Supports FSC.  
 (4) Supports DSCS-II.  
 (5) Explosive bolts to eject front beam.

ORIGINAL PAGE IS  
OF POOR QUALITY

6-4



Table 6-1b. IUS/Payload Support MMSE Utilization, 176 in Diameter  
Spacer, Payload Mounting Beam and Associated Equipment

Satellites On IUS	DSCS-II	Two DSCS-II	DSP	DSP + DSCS-II	FSC	Two FSC	FSC + DSCS-II
Total Satellite Length (in)	103	204	270	373	192	384	300
Satellite Diameter (in)	108	108	109.4	109.4	105	105	108
Total Satellite Weight (lb) <sup>(1)</sup>	1,383	2,766	2,409	3,792	1,861	3,722	3,244
MMSE Weights (lb)							
XPMB-2	249		249		249		
PMB-2		373		373 <sup>(2)</sup>		373	373 <sup>(3)</sup>
SLP-1	63	63	63	63	63	63	63
PIA-3	85	85	85	85	85	85	85
PSP-1	13	13	13	13	13	13	13
PSP-2	7	7	7	7	7	7	7
Top Deck Subtotal	(417)	(541)	(417)	(541)	(417)	(541)	(541)
PLS-4		272		272			272
PLS-6						358	
PIA-3		85		85		85	85
PMB-2		373		373 <sup>(4)</sup>		373	373 <sup>(4)</sup>
ITA-1		243		243		243	243
Separation System <sup>(5)</sup>		10		10		10	10
SLP-1		63		63		63	63
PSP-1		13		13		13	13
PSP-2		7		7		7	7
Lower Deck Subtotal		(1,066)		(1,066)		(1,152)	(1,066)
Total MMSE Weight (lb)	417	1,607	417	1,607	417	1,693	1,607
Gross Weight (lb)	1,800	4,373	2,826	5,399	2,278	5,415	4,851

(1) Has beef-up, no adapter.

(2) Supports DSP.

(3) Supports FSC.

(4) Supports DSCS-II

(5) Explosive bolts to eject front beam.

ORIGINAL PAGE IS  
OF POOR QUALITY

Table 6-2a. IUS/Payload Support MMSE Utilization  
With Modified 3.5 m Diameter XPLS  
Spacers and Associated Equipment

Satellites On IUS	DSCS-II	Two DSCS-II	DSP	DSP + DSCS-II	FSC	Two FSC	FSC + DSCS-II
Total Satellite Length (m)	2.62	5.18	6.86	9.47	4.88	9.75	7.62
Satellite Diameter (m)	2.74	2.74	2.78	2.78	2.67	2.67	2.74
Total Satellite Weight (kg) <sup>(1)</sup>	628	1,255	1,093	1,720	844	1,688	1,472
MMSE Weights (kg)							
XPMB-2	113	113	113	113 <sup>(2)</sup>	113	113	113 <sup>(3)</sup>
SLP-1	29	29	29	29	29	29	29
PIA-3	39	39	39	39	39	39	39
PSP-1	6	6	6	6	6	6	6
PSP-2	3	3	3	3	3	3	3
Top Deck Subtotal	(189)	(189)	(189)	(189)	(189)	(189)	(189)
XPLS-3a <sup>(4)</sup>		109				109	109
XPLS-3b <sup>(5)</sup>				70			
XPLS-2a <sup>(6)</sup>						59	
PIA-3		39		39		39	39
XPMB-2		113		113 <sup>(7)</sup>		113	113 <sup>(7)</sup>
Separation System <sup>(8)</sup>		5		5		5	5
SLP-1		29		29		29	29
PSP-1		6		6		6	6
PSP-2		3		3		3	3
Lower Deck Subtotal		(303)		(264)		(361)	(303)
Total MMSE Weight (kg)	189	492	189	453	189	550	492
Gross Weight (kg)	816	1,746	1,282	2,173	1,033	2,239	1,963

(1) Has beef-up, no adapter.

(2) Supports DSP.

(3) Supports FSC.

(4) Enlarged to 3.5 m diameter, retains MMSE length (4.3 m).

(5) Enlarged to 3.5 m diameter, shortened to 2.67 m.

(6) Enlarged to 3.5 m diameter, retains MMSE length.

(7) Supports DSCS-II.

(8) Explosive bolts to eject front beam.

Table 6-2b. IUS/Payload Support MMSE Utilization with Modified  
138 in Diameter XPLS Spacers and Associated Equipment

Satellites On IUS	DSCS-II	Two DSCS-II	DSP	DSP + DSCS-II	FSC	Two FSC	FSC - DSCS-II
Total Satellite Length (in)	103	204	270	373	192	384	300
Satellite Diameter (in)	108	108	109.4	109.4	105	105	108
Total Satellite Weight (lb) <sup>(1)</sup>	1,383	2,766	2,409	3,792	1,861	3,722	3,244
MMSE Weights (lb)							
XPMB-2	249	249	249	249 <sup>(2)</sup>	249	249	249 <sup>(3)</sup>
SLP-1	63	63	63	63	63	63	63
PIA-3	85	85	85	85	85	85	85
PSP-1	13	13	13	13	13	13	13
PSP-2	7	7	7	7	7	7	7
Top Deck Subtotal	(417)	(417)	(417)	(417)	(417)	(417)	(417)
XPLS-3a <sup>(4)</sup>		240				240	240
XPLS-3b <sup>(5)</sup>				155			
XPLS-2a <sup>(6)</sup>						129	
PIA-3		85		85		85	85
XPMB-2		249		249 <sup>(7)</sup>		249	249 <sup>(7)</sup>
Separation System <sup>(8)</sup>		10		10		10	10
SLP-1		63		63		63	63
PSP-1		13		13		13	13
PSP-2		7		7		7	7
Lower Deck Subtotal		(667)		(582)		(796)	(667)
Total MMSE Weight (lb)	417	1,084	417	999	417	1,213	1,084
Gross Weight (lb)	1,800	3,850	2,826	4,791	2,278	4,935	4,328

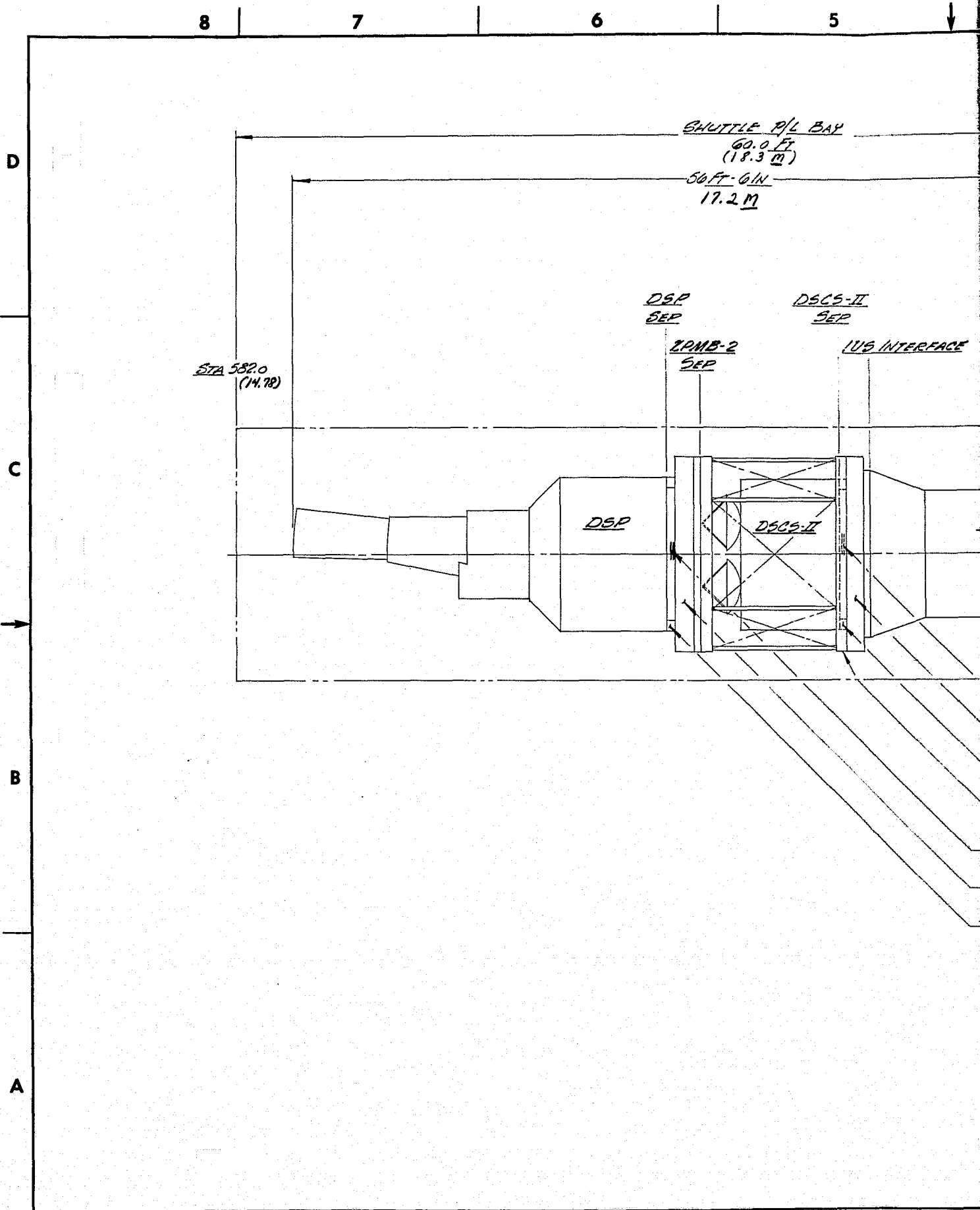
- (1) Has beef-up, no adapter.
- (2) Supports DSP.
- (3) Supports FSC.
- (4) Enlarged to 138-in diameter, retains MMSE length (170 in).
- (5) Enlarged to 138-in diameter, shortened to 105 in.
- (6) Enlarged to 138-in diameter, retains MMSE length (84.5 in).
- (7) Supports DSCS-II.
- (8) Explosive bolts to eject front beam.

ORIGINAL PAGE IS  
OF POOR QUALITY

Table 6-3. MMSE Utilization on DoD Payloads  
4.5 m (176 in) Diameter Spacer

Satellites On IUS	Four GPS	
Satellite Length [m (in)]	1.83	( 72)
Satellite Diameter [m (in)]	1.52	( 60)
Satellite Weight [kg (lb)]	397	(875)
Total Satellite Weight [kg (lb)]	1,588	(3500)
MMSE Weight [kg (lb)]		
SPMB-1	80.7	(178)
Two SLP-1	57.2	(126)
Two PIA-2	51.7	(114)
Two PSP-1	11.8	( 26)
Two PSP-2	<u>6.4</u>	<u>( 14)</u>
Top Deck Subtotal	207.8	(458)
XPLS-2	50.8	(112)
Separation System <sup>(1)</sup>	4.5	( 10)
XPMB-2	113.0	(249)
PIA-2	25.9	( 57)
SLP-1	28.6	( 63)
PSP-1	5.9	( 13)
PSP-2	<u>3.2</u>	<u>( 7)</u>
Second Deck Subtotal	231.8	(511)
XPLS-2	50.8	(112)
Separation System <sup>(1)</sup>	4.5	( 10)
XPMB-2	113.0	(249)
PIA-2	25.9	( 57)
SLP-1	28.6	( 63)
PSP-1	5.9	( 13)
PSP-2	<u>3.2</u>	<u>( 7)</u>
Third Deck Subtotal	231.8	(511)
Total MMSE Weight [kg (lb)]	671.3	(1480)
Gross Weight [kg (lb)]	2,259	(4980)

(1) Explosive bolts to eject forward beam.



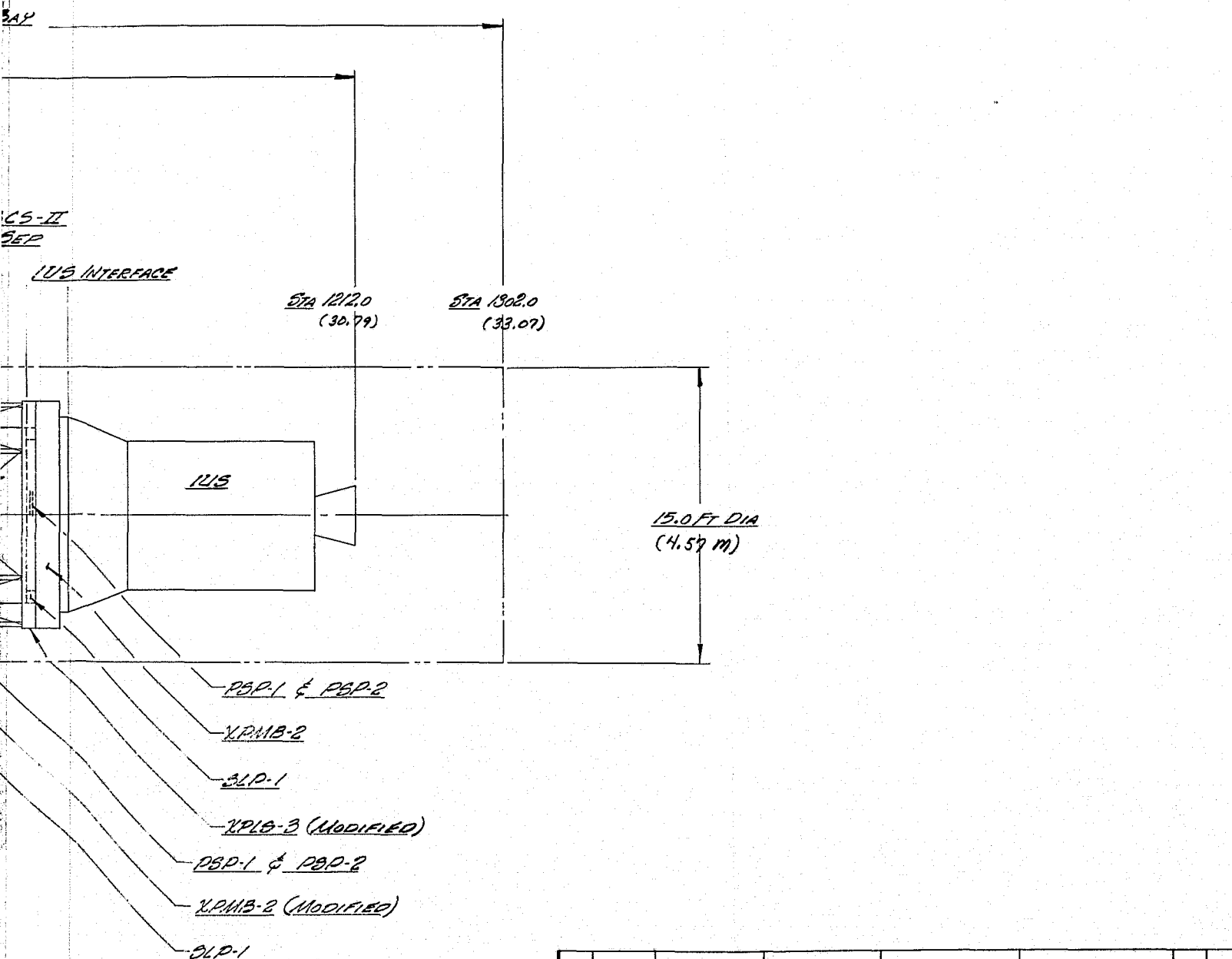
1/78 DIETERICH-PORTY CLEARPRINT 300

ORIGINAL PAGE IS  
OF POOR QUALITY

FOLDOUT FRAME

PRECEDING PAGE BLANK NOT FILMED

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

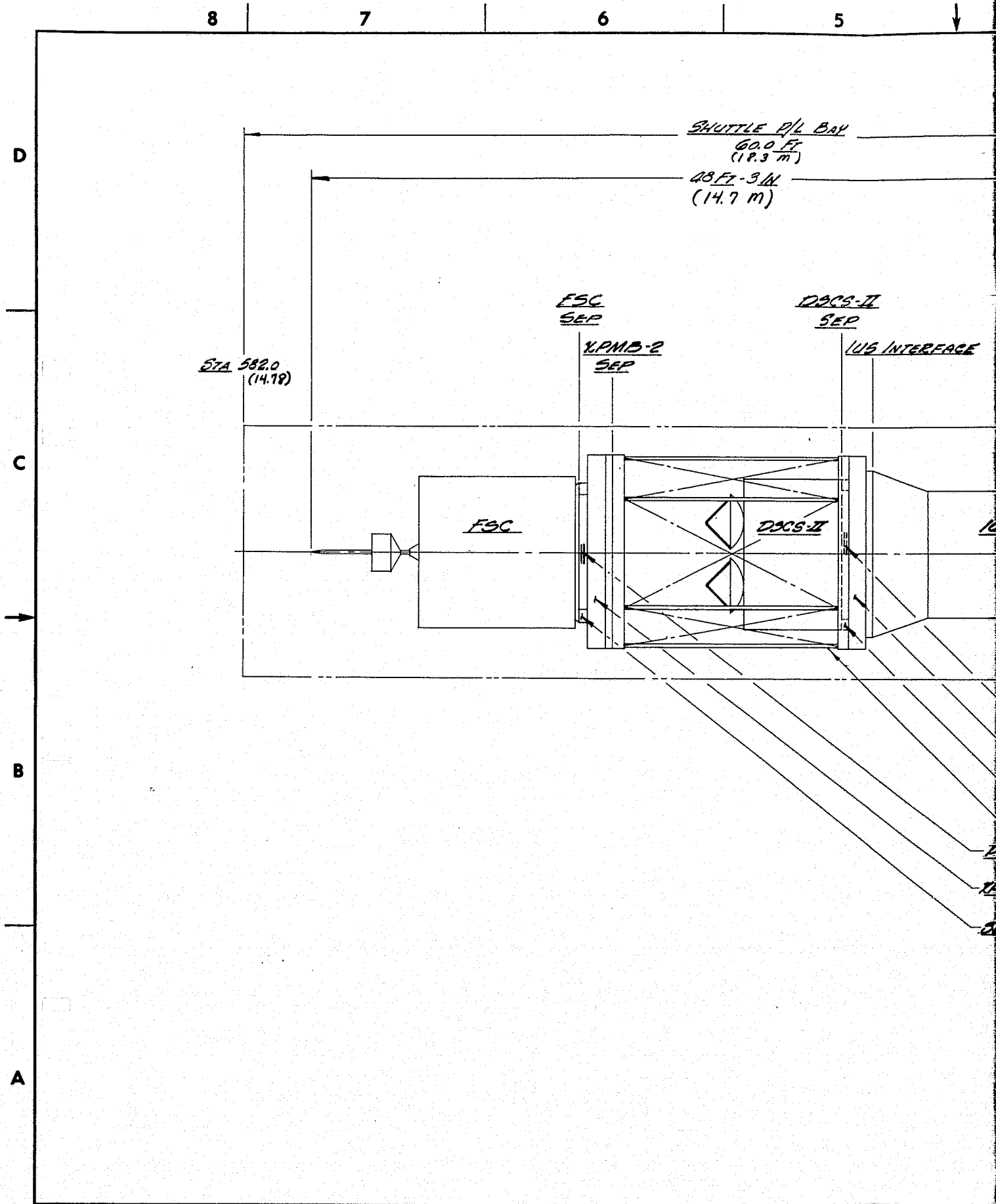


QTY REQD	CODE IDENT	PART NO. OR IDENTIFYING NO.	PART NAME	MATERIAL	SPECIFICATION	ZONE	ITEM NO.
PARTS LIST							

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES			DRAWN <i>COOLEY</i> CHECKED APPROVED APPROVED	DATE <i>9/27/75</i> DATE DATE	<b>THE AEROSPACE CORPORATION</b> EL SEGUNDO, CALIFORNIA
TOLERANCES ARE: XX ± .03    .XXX ± .010    ANGLES ± 0° 30'			Figure 6-1.    DSF and DSCS Payloads in Tandem Configuration 3.3 m (150 in) Spacer		
NEXT ASSY USED ON APPLICATION			SIZE: <b>D</b> CODE IDENT NO. <b>12782</b> DRAWING NO.		
			SCALE    SHEET		

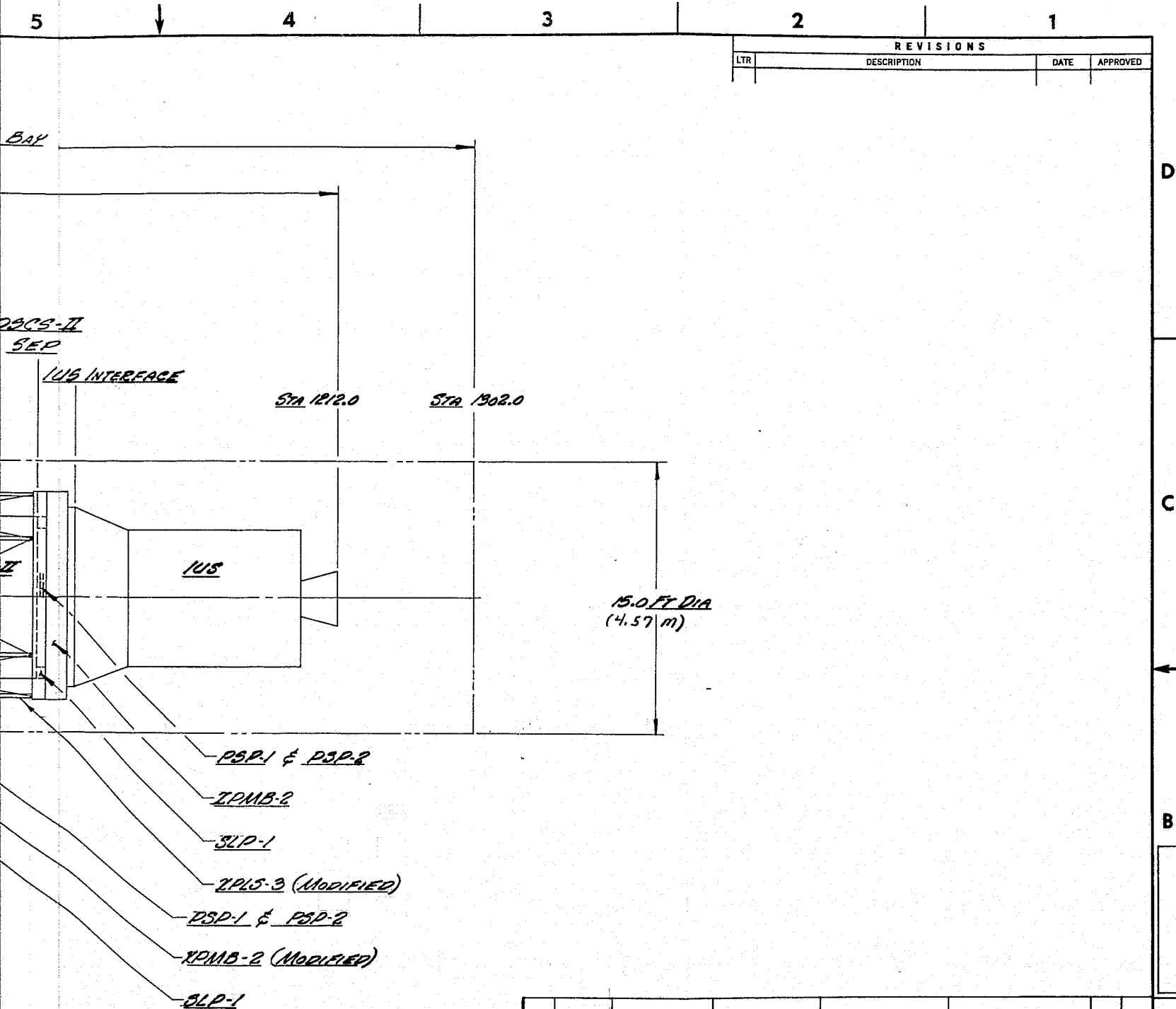
6-9 **2**

**FOLDOUT FRAME**



FOLDOUT FRAME

PRECEDING PAGE BLANK NOT FILMED



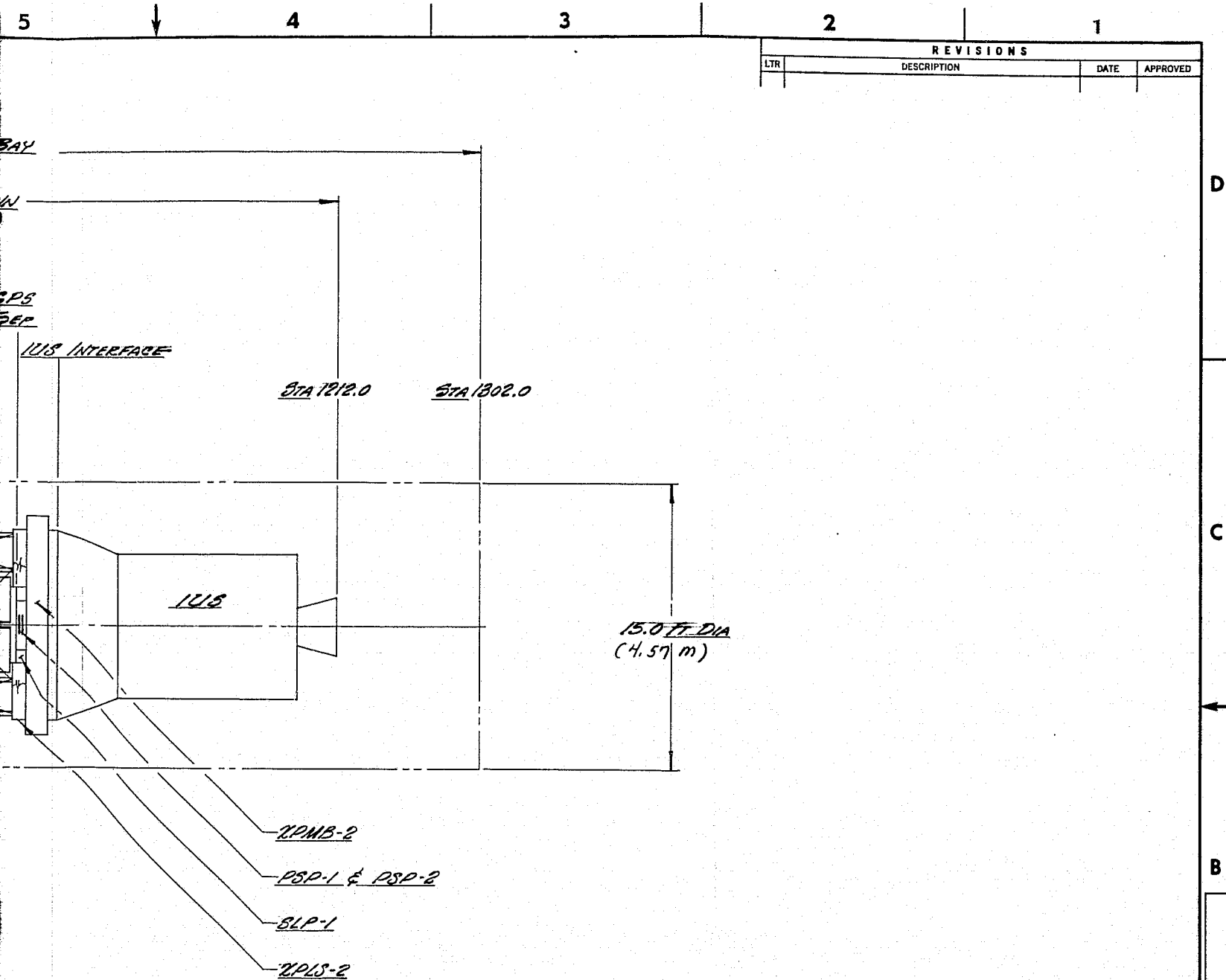
QTY REQD	CODE IDENT	PART NO. OR IDENTIFYING NO.	PART NAME	MATERIAL	SPECIFICATION	ZONE	ITEM NO.
PARTS LIST							

NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		DRAWN <i>COOLEY</i>	DATE <i>9-24-75</i>	<b>THE AEROSPACE CORPORATION</b> EL SEGUNDO, CALIFORNIA
TOLERANCES ARE:		CHECKED		
XX ± .03	XXX ± .010	APPROVED		
ANGLES ± 0° 30'		APPROVED		
				Figure 6-2. FSC and DSCS-II Payloads in Tandem Configuration 4.3 m (170 in) Spacer
				SIZE <b>D 12782</b> SCALE      SHEET








REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

QTY REQD	CODE IDENT	PART NO. OR IDENTIFYING NO.	PART NAME	MATERIAL	SPECIFICATION	ZONE	ITEM NO.
PARTS LIST							

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES			DRAWN <b>COOLEY</b>	DATE <b>9-23-78</b>	 <b>THE AEROSPACE CORPORATION</b> EL SEGUNDO, CALIFORNIA
TOLERANCES ARE:			CHECKED		
XX ± .03	XXX ± .010	ANGLES ± 0° 30'	APPROVED		
			APPROVED		
NEXT ASSY APPLICATION			SIZE <b>D 12782</b>		DRAWING NO. SHEET

AEROSPACE FORM 888 REV. 5-76

FOLDOUT FRAME

There is a great deal of wasted space in the payload bay for the configuration shown in Figure 6-3. In addition, the 2235 kg (4928 lb) payload weight shown in Figure 6-3 for this configuration is very low compared to the capability of the IUS to the GPS destination. [greater than 4082 kg (9000 lb)]. It is recommended that NASA consider payload spacers in combination with the side-by-side payload mounting beam so that three or four side-by-side payload mounting beams could be configured to fly on the IUS with six or eight payloads. It is also recommended that NASA consider increasing the number of payloads accommodated on each side-by-side payload mounting beam so that up to four payloads could be mounted on one beam.

The sequence of events for deployment of the multiple payloads on IUS is illustrated below using the FLEETSATCOM (FSC) and DSCS multiple payload configuration (see Figure 6-2).

1. IUS terminates powered flight in a phasing orbit at the geosynchronous 24-hour satellite destination.
2. The FSC is deployed by the latch and push-off mechanism (SLP-1). This action also disconnects and separates the payload service plates (PSP-1, -2).
3. The payload mounting beam (XPMB-2) which supports FSC is separated by blowing explosive bolts holding it by the spacer (XPLS-3).
4. The DSCS-II satellite is separated from the payload mounting beam supporting it by the latch and push-off mechanism (SLP-1). Again, the payload service plates between DSCS and the IUS are separated by this action. The DSCS satellite separation velocity drives the satellite out through the spacer opening.

Multiple payloads boosted to 24-hour synchronous orbit for DoD can use the IUS/payload interface equipments if the IUS capability to synchronous equatorial orbit is 1769 kg (3900 lb) or more. The following capacities are required:

1. Two DSCS satellites, 1769 to 1951 kg (3900 lb to 4300 lb)
2. One DSCS plus one FSC, 1951 kg to 2540 kg (4300 lb to 5600 lb)
3. One DSCS plus one DSP, 2177 kg to 2676 kg (4800 lb to 5900 lb)
4. Two FSC satellites, 2268 kg to 2858 kg (5000 lb to 6300 lb).

These multiple payload configurations assume the MMSE payload spacer diameter XPMB-2 has been modified. Thus, for DoD payloads transitioning from expendable launch vehicles to the Shuttle/IUS, it is feasible to use MMSE to standardize the payload/IUS interface.

For carrying multiple GPS payloads on the IUS, the IUS performance to the GPS orbit will be at least 4082 kg (9000 lb) payload. Thus the GPS is expected to be compatible with MMSE for launching up to four GPS without modification of the MMSE and could be compatible with MMSE modified as previously discussed in this section for up to eight payloads.

The potential operational advantages for IUS configurations using standardized MMSE interface equipment needs more study. Potential advantages for this approach include (1) the flexibility to substitute payloads on a multiple payload configuration, (2) reduction in integration costs and time, and (3) in the far term, if a upper stage payload retrieval capability is developed, standardizing the interface will make it feasible to deploy one payload and retrieve another on the same interface equipment.

## 7. SUMMARY OF STUDY ACCOMPLISHMENTS

The data bank on which this study was based was extensive (see reference list, Section 9). Both the systems analysts and the specialists working on this study were required to familiarize themselves with the material contained in most of the references as it pertained to their particular area. Each was required to understand the definition and use of the MMSE, the satellites to which the equipments were being applied, the STS side of the interface, and the interface equipment needs for each of the satellites studied.

The study was accomplished by carrying out the following steps.

1. Relate the DoD satellite and interface data available to the DoD Space Mission Model.
2. The DoD payload interface study data for the Global Positioning Satellite (GPS), DSCS-II, Defense Support Program (DSP), FleetSatCom (FSC), Defense Meteorological Support Program (DMSP), SOSS, and a Radio Isotope Thermoelectric Generator (RTG) were collected and the data from the reports summarized. Payload Data Sheets were completed describing each of the payloads as they were configured for the payload interface studies. These data sheets are on file at The Aerospace Corporation. The DoD airborne ancillary equipment needed to support the satellites studied were listed and briefly described.

None of the reported studies covered launch site or ground support equipment.

3. MMSE lists were made up containing all the MMSE from the two catalogs (References 1 and 2). These equipment lists were paired down by eliminating equipments not recommended by MSFC or KSC for further consideration by NASA.

4. The NASA launch site MMSE was studied for application to each of 12 DoD payloads in the Space Mission Model.
5. Each equipment on the on-line or airborne MMSE list was considered against the on-line interface equipment needs for each of the DoD satellites. This resulted in a list of candidate MMSE to be studied for application to the DoD payloads. For each piece of equipment studied, a MMSE Data Sheet was completed listing the DoD satellites to which the equipment was potentially applicable and discussing the rationale for its use.
6. A conceptual design mass properties and layout analysis of the payload/IUS interface (MMSE) structure was accomplished. The best combination of MMSE for supporting multiple payloads on the IUS was derived using the application rules described on Page 95 of Reference 15. Layouts were made of the three most complex payload installations on the IUS.
7. A design concept effort of the universal cradle/tilt table concepts was accomplished. Other orbiter/payload interface structures, such as platforms and payload support racks, were also considered.
8. MMSE application studies based on the contractor recommended requirements for each of the DoD satellite interfaces were accomplished in the following areas:
  - a. Cabling for avionics and power
  - b. Auxiliary power units
  - c. Fluid lines and purging
  - d. RTG cooling
  - e. Payload shroud.
9. The results obtained for interface equipment application to the six DoD satellites studied was extrapolated where possible to the remaining six satellites studiable in the DoD Space Mission Model. Where similarity existed between the six additional satellites and those studied, similarity was used to access the applicability of each equipment to the additional satellite.

10. The ancillary equipment needed by DoD but not included in the NASA MMSE was reviewed for consideration as to whether recommendations should be made to NASA to include additional ancillary equipment in future MMSE studies.
11. The results of the Ancillary Equipment Study were summarized and discussed with NASA Headquarters, NASA MSFC, and SAMSO/Aerospace.

## 8. RECOMMENDATIONS FOR ADDITIONAL EFFORT

The need for additional effort in the ancillary equipment area stems from two concerns: (1) the ancillary equipment needs for DoD payloads are changing, both as a result of DoD guidelines and directives and as a result of improved definitions of the STS satellite configurations and the STS itself; (2) NASA is continuing with definition studies and application analyses to NASA payloads for the MMSE (NASA is expected to redefine MMSE in several of the areas); and (3) assessment of the justification for MMSE application to DoD satellites needs to be made by comparing the use of MMSE with alternate equipment.

Since in FY 1976 Martin Marietta will be redefining MMSE in the following areas which may have application to DoD payloads, it is recommended that these redefined MMSE be reviewed to find potential DoD uses:

1. Attitude reference sensors
2. Electrical power equipment
3. Electrical cabling
4. RTG cooling unit
5. Payload shroud
6. Purge system
7. IUS to payload interface structure
8. Orbiter to payload interface structure
9. On-orbit servicing equipment.

The MMSE that is applicable to DoD payloads should then be evaluated by comparing cost, weight, and operational advantages with alternative approaches.



## 9. REFERENCES

1. Catalogue, Multi-Use Mission Support Equipment (MMSE), Martin Marietta, MCR-75-229 (June 1975).
2. Revision B, MMSE Catalogue, Multi-Use Mission Support Equipment (Launch Site), Martin Marietta, Contract NAS8-30847 (April 1975).
3. Final Review, Multi-Use Mission Support Equipment, Martin Marietta, Contract NAS8-30847 (May 1975).
4. Executive Summary Report, Launch Site Multi-Use Mission Support Equipment, Martin Marietta (April 1975).
5. Final Report, Multi-Use Mission Support Equipment (MMSE) Study, Volume II, Appendix A, Equipment Requirements Analysis, Martin Marietta, MCR-75-189-2 (April 1975).
6. Final Report, Multi-Use Mission Support Equipment (MMSE) Study, Volume III, Appendix B, Equipment Definition and Inventory, Martin Marietta, MCR-75-189-3 (April 1975).
7. Final Report, Multi-Use Mission Support Equipment (MMSE) Study, Volume IV, Appendix C, Logistics and Ground Operations, Martin Marietta, MCR-75-189-4 (April 1975).
8. Final Report, Multi-Use Mission Support Equipment (MMSE) Study, Volume V, Appendix D, Programmatic Analysis, Martin Marietta, MCR-75-189-5 (April 1975).
9. DoD Space Transportation System (STS) Payload Interface Study, Final Report, McDonnell Douglas Astronautics Company/TRW Systems Group, SAMSO-TR-73-280-VOL II (October 1973).
10. DoD Space Transportation System (STS) Payload Interface Study, FY 74 Extension, Final Report, McDonnell Douglas Astronautics Company/TRW Systems Group, SAMSO-TR-74-198 (October 1974).
11. DoD Space Transportation System (STS) Payload Interface Study, FY 75 Extension, Final Report, McDonnell-Douglas Astronautics Company/TRW Systems Group, SAMSO-TR-75-136 (May 1975).

12. DoD/STS Payload Interface Study, FY 75 Extension, Final Briefing, McDonnell Douglas Astronautics Company (4 April 1975).
13. Global Positioning System Space Transportation System Interface Analysis, CDRL Item A01J, Space Division, Rockwell International, SD74-GP-0018, Contract F04701-74-C-0527 (3 January 1975).
14. Interface Verification Equipment Study, Space Division, Rockwell International (19 February 1975).
15. Interface Concept Assessment Report, Part II, Space Division, Rockwell International, SD 75-SH-0136 (30 June 1975).
16. Payload Interface Concept Assessment Briefing, Rockwell International, DoD Space Transportation System Support, SSV75-14 (27 June 1975).
17. PSS, Payload Specialist Station, NASA MSFC, MSFC Form 3304, (May 1975).
18. Multiuse Mission Support Equipment, Pointing Control and Stabilization, NASA MSFC, MSFC Form 3304 (no date).
19. Real-Time Contamination Monitor, NASA MSFC, MSFC Form 3304 (June 1975).
20. Flight Transportation System for Outsized Cargo, NASA MSFC, MSFC Form 3304 (May 1975).
21. Review of Multiuse Mission Support Equipment (MMSE) Program Development Plan Material, NASA MSFC, MSFC Form 3304 (June 1975).
22. DoD Space Mission Model (FY 1980 - FY 1991), Revision 4 (U), Hq USAF/RDSA (27 November 1974) (Secret).